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RAPID DETERMINATION OF RADON DAUGHTER CONCENTRATIONS

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RAPID DETERMINATION OF RADON DAUGHTER CONCENTRATIONS

A report prepared by J. Bigu, CANMET, Elliot Lake Laboratory under contract to the Atomic Energy Control Board.

ABSTRACT

A technical evaluation of four radon 222 progeny measuring instruments has been conducted. The evaluation has been carried out under laboratory controlled conditions and at several locations in an underground uranium mine. The laboratory evaluation consisted of a thorough study of the behaviour and performance of the instruments under a wide variety of environmental conditions such as radon 222 gas concentration, radon 222 progeny concentration, temperature, relative humidity, aerosol concentration, and gamma-field exposure. The four instruments tested were: the Pylon WL-1000C, the MDA IWLM-811, the MIMIL IIM, and the EDA WLM-30. The readings of the instruments were compared with a widely accepted radon 222 progeny concentration measuring method, namely, the Thomas-Tsivoglou method. Two variables affected two instruments significantly, namely, under high aerosol concentration conditions, one of the instruments (EDA WLM-30) ceased to operate because of filter loading. The other variable was gamma-field exposure which affected another instrument (MDA-811) adversely. The instruments were rated according to several criteria. The overall best performer was the MIMIL IIM, although other instruments also fared quite well under a variety of experimental conditions.

RÉSUMÉ

Le présent rapport traite de l'évaluation technique de quatre appareils de mesure des produits de filiation du radon 222 dans des conditions de laboratoire contrôlées et en plusieurs endroits d'une mine d'uranium souterraine. En laboratoire, on a évalué en détail le comportement et le rendement des appareils dans une grande variété de conditions environnementales, comme la concentration de radon 222 à l'état gazeux, la concentration des produits de filiation du radon 222, la température, l'humidité relative, la concentration des aérosols et l'exposition au champ de rayonnement gamma. Les quatre appareils évalués étaient un Pylon WL-1000C, un MDA IWLM-811, un MIMIL IIM et un EDA WLM-30. Les relevés des appareils ont été confrontés à une méthode très reconnue de mesure de la concentration des produits de filiation du radon 222, soit la méthode Thomas-Tsivoglou. Deux variables ont affecté deux appareils de façon importante : l'appareil EDA WLM-30, notamment, soumis à une concentration élevée d'aérosols, s'est arrêté de fonctionner car son filtre était saturé. L'exposition au champ de rayonnement gamma est l'autre variable qui a nui au bon fonctionnement d'un autre appareil (MDA-811). Les appareils ont été cotés selon plusieurs critères. L'appareil MIMIL IIM a offert le meilleur rendement, bien que les autres appareils se soient aussi assez bien classés dans diverses conditions expérimentales.

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IMPORTANT NOTES

Although the original AECB contract stipulated the radon 222 progeny instrumentation to be evaluated using the Kustnez method as the reference method, the contractor has used instead the modified Tsivoglou method, hereafter referred to as the Thomas-Tsivoglou method. The latter method has several advantages over the Kustnez method, namely:

1. it is more accurate;
2. it permits calculation of the (individual) radon 222 progeny concentrations;
3. because of items 1 and 2, the state of disequilibrium of the radon 222 progeny can be calculated and, hence, a more accurate evaluation (and a better understanding of the behaviour) of the instrumentation tested can be attained.

The assistance of E. Edwardson throughout this entire project is gratefully acknowledged.

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INTRODUCTION

Radioactive environments pose potential hazards to human health. It is generally recognized that inhalation of radon (^{222}Rn) progeny results in the largest single contribution to the average effective dose equivalent received by members of the public (1). Monitoring of ^{222}Rn progeny (RnP) is, therefore, of great importance to assess potential radiation health hazards associated with occupational exposure of RnP of uranium mine and mill workers and the general public alike. The monitoring of radioactive environments is also of practical interest for engineering purposes such as the maintenance of reliable air quality control in working areas, and to ascertain ventilation conditions in enclosed or confined working locations.

The accuracy with which ^{222}Rn and its progeny can be measured depends to a large extent on the type of instrument and technique used. Hence, testing and calibration of radiation instrumentation in reference radioactivity atmospheres cannot be stressed enough.

Radon-222 and its progeny (RnP) can be measured by means of a variety of commercially available instruments of the passive and active type, using techniques which range from grab-sampling to time-integrating and continuous monitoring, employing a variety of radioactivity counting methods.

Testing and calibration of instrumentation is best carried out under laboratory controlled conditions in specially designed chambers, sometimes referred to as 'radon boxes'. However, because this instrumentation is mostly used in the field where harsh environmental conditions usually prevail (such as high relative humidity (RH), high or low temperature (T), large aerosol and dust concentration, varying airflow conditions and radioactivity levels, and passing motorized vehicles), proper testing and calibration protocols and procedures are not complete unless an evaluation of these instruments is conducted under actual field conditions.

This report presents data on a technical evaluation and calibration of several ^{222}Rn progeny instruments of the active type (grab-sampling and continuous monitoring) of common use by mine and mill inspectors of the Atomic Energy Control Board (AECB), the Ontario Ministry of Labour (MOL), and personnel at the ventilation departments of uranium mines and uranium mills.

The evaluation of the instrumentation was carried out in a Radon/Thoron Test Facility (RTTF) of the walk-in type (2) and in an underground uranium mine. This investigation was suggested by the AECB under contract to the Elliot Lake Laboratory (Mining Research Laboratory (MRL), CANMET, Energy, Mines and Resources Canada) No. 4.127.1, MRL No. 143902-07-5.

The Elliot Lake Laboratory has conducted a great deal of radiation calibration work over the years. But most importantly, it has played a key role in Canada in the development of ^{222}Rn and ^{220}Rn progeny instrumentation, and in the transfer of this technology to the mining industry, instrumentation manufacturing companies, government agencies, and the private sector (3-15).

THEORETICAL BACKGROUND

Because ours is a complex and often not easily controllable environment in which complex, as well as not fully understood, interrelationships exist between different environmental variables, it is important that the technical evaluation of radiation instrumentation be conducted with great care and precision. This requires a good understanding of a diversity of physico-chemical phenomena constantly at play, as well as knowledge of the interaction between the instrument to be evaluated, the variable that needs to be measured, and the environment where the instrument is to be operated.

It should be noted that different instruments specifically designed to measure the same radiation variable, e.g., ^{222}Rn concentration or Potential Alpha Energy Concentration [PAEC(Rn)], may respond differently to the same environmental factor, and hence, radiation variable, according to whether the instrument(s) are of the following types:

a) Passsive type,

b) Active type,

c) Grab-sampling type,

d) Continuous, time-integrating type.

Factors that may affect the response or performance of the instrument include:

a) Air concentration and size distribution;

b) Air moisture content, i.e., relative humidity;

c) Temperature;

d) Airflow conditions about the instrument;

e) Radioactivity fields and electromagnetic fields;

f) Fluctuating radioactivity concentrations or concentration gradients;

g) 'Mineral' dust, e.g., silica (SiO_2) dust, and dust containing long-lived radionuclides, i.e., Long-Lived Radioactive Dust (LLRD).

Before discussing the potential effect of items a) to g) on instrument performance it will be useful to define briefly the meaning of instrumentation of the active, passive, grab-sampling, and continuous types.

1. Grab-Sampling. Air samples are taken for short periods of time, typically 5 to 10 min. Radioactivity counting, e.g., α-particle activity, is carried out after the sampling period.

2. Continuous Monitoring. Air samples are taken on a continuous basis lasting typically from several days to several weeks. Counting of radioactivity is conducted by the same instrument and concurrently with air sampling. Hence, the radioactivity count, or activity, for short, is continuously being 'integrated' by the instrument.

3. Passive Sampling. No active mechanical devices, i.e., air sampling pumps, are necessary. Air sampling is done by passive means such as diffusion

barriers or membranes which are used to separate the atmosphere to be sampled from a 'sensitive' volume which is employed to collect and measure the sample.

4. Active Sampling. Air is sampled by drawing air through a filter material, housed in an adequate filter holder, by means of an air sampling pump.

Both, grab-sampling and continuous monitoring can be of the active type and the passive type. There are obvious advantages as well as disadvantages in using continuous monitoring over grab-sampling methods, or passive over active techniques. For example, active sampling is usually more efficient and sensitive than passive sampling. However, the former is typically more complex, more susceptible to mechanical problems, and usually more costly to operate and maintain than passive sampling. Furthermore, while data obtained by grab-sampling methods are virtually representative of instantaneous, real time, radioactivity environmental conditions, continuous monitoring shows time-lags which sometimes are not acceptable for practical purposes. Time-lags between actual field conditions and the 'instantaneous' response of the instrument to these conditions arise because of the following:

a) rapidly fluctuating radioactivity concentration conditions;
b) the physical nature of the growth and decay of radioactivity in the sampling instrument; and
c) the radioactive half-lives of the radioisotopes under consideration.

For a fast change in airborne radioactivity concentration such as that corresponding to a step-function type, the time-lag in the response of the instrument will be of about 1 hour for ^{222}Rn progeny atmospheres, and over 15 hours for thoron (^{220}Rn) progeny atmospheres. In other words, the instrument will not fully react to these rapid changes before the above indicated periods of time. A rapid succession of changes in the activity concentration levels may not even be detected at all by the instrument depending on the intensity and frequency of these variations.

The choice of one type of instrument over another must be based on a number of factors including long-term reliability, ruggedness, initial investment and routine maintenance, ease of operation and data processing and retrieval. It must also be based on their performance and response to field and laboratory controlled conditions, as indicated above and discussed below.

The remainder of this section will be devoted to a short discussion on the potential, or experimentally verified, response of ^{222}Rn progeny instrumentation to a number of important environmental factors to which they (the instrumentation) are exposed.

1. AEROSOL CONCENTRATION AND SIZE DISTRIBUTION

Radon progeny are originally formed in an atomic, i.e., 'unattached', positively charged state (16,17). Because of the small size of these recently formed radioactive particles, they diffuse readily to walls and other large surfaces.

Aerosols are important because they serve as 'material' substrata for ^{222}Rn progeny to attach to. In general, the higher the aerosol concentration, the higher is the probability of ^{222}Rn progeny to attach to aerosols. As the aerosol concentration decreases an increasingly larger ^{222}Rn progeny fraction remains in an unattached state, and hence, they readily plate-out to large surfaces.

The probability of ^{222}Rn progeny attachment to aerosols is also dependent on the size of the aerosols and the physico-chemical nature of the aerosol milieux. It has been observed that preferential attachment of ^{222}Rn progeny to aerosol occurs in the submicron size range, and at about 0.1 to 0.2 μm (18,19).

It is not difficult to imagine that the mechanical configuration of the ^{222}Rn progeny instruments' sampling head may play a significant role in the response of the instrument, particularly at low aerosol concentrations for which plate-out mechanisms become important. Under low aerosol concentration conditions, removal of airborne ^{222}Rn progeny by plate-out on the surface of the sample holder is to be expected, even for open face sampling heads. For in-line sampling heads, e.g., in-line filter holders, the plate-out problem can become quite severe. The net result will be an underestimation of the radioactivity concentration level. Hence, it is important to evaluate instrumentation under moderate or high aerosol concentrations ($>10^4$ cm^{-3}), as well as low aerosol concentrations ($<10^3$ cm^{-3}).

There are other factors which should also be considered with regard to the sampling head which may affect plate-out mechanisms, such as factors including the roughness of the sampling head surface, the sampling airflow rate, and the electrical state (presence or absence of charge) of the surface.

2. AIR MOISTURE CONTENT

The moisture (H_2O) content of air in which a given aerosol cloud is dispersed has the following effects:

a) changes the electrical characteristics (state) of large surfaces,

b) increases the aerosol concentration (N),

c) interacts with aerosols (physico-chemical interactions) by increasing their size, serving as nucleation sites, and as a hypothetical potential source of hydroxyl radicals formed through nuclear interactions (α-, β-, or γ-radiation) with H_2O molecules.

A general effect of high relative humidity (RH) is to increase the aerosol concentration, reduce plate-out phenomena and neutralize electrical charge on large surfaces.

However, high RH can have other, often negative, effects on the electronic components of instrumentation. It can cause short circuits in electrical components in addition to causing other disruptive effects. High air moisture content is a frequent cause of instrument malfunction in harsh environments such as wet underground mines. These adverse effects can be eliminated in certain cases, e.g., for low power electronic components where heat dissipation is not a serious concern, by proper moisture sealing of the electronics case.

3. TEMPERATURE EFFECTS

It is well known that most electronic components cannot operate satisfactorily outside certain temperature ranges. Furthermore, temperature may also adversely affect sealing materials (e.g., gaskets, filter materials) used to collect airborne radioactivity, as well as other components of ^{222}Rn progeny instrumentation. If an instrument is to operate under extreme temperature conditions, e.g., too hot or too cold, great care should be exercised to shield and protect the instrument against these extreme conditions, otherwise its performance will visibly and rapidly deteriorate becoming erratic and unreliable. High air moisture content and high temperatures are a particularly bad combination of factors that can cause instrument performance to deteriorate significantly.

4. AIRBORNE DUST

Because of mining operations, the operation of heavy mining equipment and vehicles, and reentrainment of particulate matter deposited on mine walls by turbulent airflow in mine galleries, significant amounts of airborne dust are found in underground (UG) mines. For simplicity, these dusts can be broadly divided into two main categories, namely:

a) 'conventional' or 'normal' dust, e.g., mineral dust, large diesel particulates, and the like; and

b) dusts containing long-lived radionuclides such as ^{238}U, ^{235}U, ^{232}Tn, ^{228}Th, ^{226}Ra and ^{224}Ra (from the natural U and Th radioactive decay chains) which range in radioactive half-lives from hundreds of years to several millions of years. Dust containing long-lived radionuclides will be referred to here as Long-Lived Radioactive Dust (LLRD).

While 'conventional' dust may or may not be radioactive, LLRD is simply some type of dust, e.g., silica, which contains radionuclides in its intercrystalline structure. Significant differences may arise between LLRD and 'normal' dust, apart from radioactivity considerations, because of the presence of radionuclides. One such difference may be in electrical charge, to mention but one possibility. It should be noted, however, that regardless of how low, all dust is radioactive to some extent.

The most immediate effect of air sampling, say by means of a filter, in the presence of significant dust concentration levels is filter loading. The deposition of dust on a filter material where ^{222}Rn progeny is collected has two effects:

a) particle self-absorption,

b) energy degradation.

Because of the finite thickness of the dust layer deposited on the filter during the sampling period, α-particles emitted from the surface of the filter material lose part of their energy through collision mechanisms. Furthermore, because of scattering processes between α-particles and dust in the filter, the energy distribution of the emerging α-particles broadens. As a result, α-particles reaching the detector will be of lower energy and their energy will spread over a wider spectrum. Because α-particle detectors are sensitive to the above factors, their ability to detect α-particles, i.e., counting efficiency, will be altered and, in most cases, their efficiency will be decreased. Finally, contamination by Long-Lived Radioactive Dust (LLRD) of the sampling head, α-particle detector, and other parts of the sampling and detection systems may become so serious as to preclude low activity and medium activity measurements to be conducted with the necessary accuracy.

If the thickness of the dust layer deposited on the filter is comparable to the range of the α-particles in the dusty material, severe particle absorption will take place, and the α-particle count may be reduced substantially.

While self-absorption, energy degradation, and energy spectrum broadening are in general of no great concern for grab-sampling methods because of the short sampling times involved, the above phenomena can become quite severe and detrimental for continuous monitoring systems. Steady filter loading not only causes a drastic redution in α-particle count, but a substantial increase in airflow resistance through the filter which can cause pump failure. It is not unusual for continuous monitoring systems to fail to operate after less than one week of continuous sampling when they are exposed to moderate dusty environments.

5. RADIOACTIVITY CONCENTRATION LEVELS

Radon-222 progeny monitoring systems are not strictly linear over the wide range of concentration levels encountered under actual field conditions. This is due to the inherent non-linearity of some detecting and amplifying systems, and other factors not discussed here. At the two ends of the radioactivity concentration spectrum, the situation is as follows:

a) At very low concentration levels, the accuracy of activity measurements is severely limited by statistical considerations;

b) At very high concentration levels, strong radioactive plate-out, saturation effects, and detector contamination are the limiting factors. Detector contamination arises from long-lived radionuclides which are formed by the decay of the short-lived decay products of ^{222}Rn, e.g., ^{210}Pb and ^{210}Po.

Another important consideration is the sensitivity of certain nuclear detectors, particularly particle crystal scintillators, to γ-ray fields. These detectors are sensitive to γ-radiation in addition to, say, α-particles. This constitutes a serious drawback in underground (UG) U-mines with high ore grades because γ-fields in these mines can seriously interfere with α-particle measurements, as will be shown later.

6. UNDERGROUND AIRFLOW CONDITIONS AND SAMPLING FLOWRATE

Underground airflow rate (ventilation) conditions and sampling airflow rate are two important quantities which when significantly mismatched can lead to less than ideal isokinetic sampling conditions, e.g.:

a) Highly turbulent UG airflow conditions, i.e., high Reynolds (Re) number, and low airflow rate sampling conditions;

b) Stagnant ventilation conditions, i.e., low Re number, and very high airflow rate sampling situations.

In addition to items a) and b), ventilation conditions and the sampling airflow rate play an important role in plate-out phenomena, aerosol and dust reentrainment (blow off) mechanisms, and other phenomena which affect instrument performance.

7. NON-STEADY RADIATION CONDITIONS

As previously discussed, non steady-state radiation conditions can greatly affect the performance of radiation monitoring systems. This is particularly true of continuous, time-integrating, monitoring instrumentation as pointed out above. The effect of rapidly fluctuating radiation conditions will be amply illustrated in the section on experimental results.

It should be noted that in the sub-sections above the effect of each of a number of variables on instrument performance have been discussed. However, in actual practice, two or more of these variables may act simultaneously. While in some cases the effect of one component of a pair of variables may counteract the effect of the other component (variable), in other cases the effect may be compounded.

The discussion in the preceeding section alerts the reader to the potential difficulties arising in the evaluation of radiation (^{222}Rn progeny) instrumentation for accurate field and laboratory work. Furthermore, it shows that a thorough technical evaluation is far from being straightforward and that many factors have to be taken into consideration. Hence, designing and carrying out protocols for the evaluation of radiation instrumentation is complex, time consuming, difficult, labour intensive, and costly.

The protocol that was designed to test, evaluate and calibrate the instrumentation of interest to the AECB will be described in the next section. A brief description of the instruments tested will follow in this section.

EXPERIMENTAL PROTOCOL

A testing protocol was designed to evaluate the instrumentation of interest. Five variables were identified as of primary importance in order to fully evaluate the performance of the instrumentation under investigation. The variables were:

a) ^{222}Rn progeny concentration,

b) aerosol concentration and size distribution,

c) relative humidity,

d) temperature, and

e) γ-field.

The protocol called for testing under the following conditions, whenever possible:

1. Radon Progeny Concentration

The following values were chosen:

0.05 WL(Rn) or 1.04 μJm^{-3}

0.25 WL(Rn) or 5.20 μJm^{-3}

0.50 WL(Rn) or 10.40 μJm^{-3}

1.00 WL(Rn) or 20.80 μJm^{-3}

The conversion factor from ^{222}Rn progeny Working Level, WL(Rn), and Potential Alpha Energy Concentration (PAEC) is: 1 WL(Rn) = 20.8 μJm^{-3}.

2. Aerosol Concentration and Size Distribution

Two aerosol concentration ranges were chosen, namely, 'low' aerosol concentration ($<1.0 \times 10^{-3}$ cm^{-3}) and moderate aerosol concentration ($\geq 1.0 \times 10^4$ cm^{-3}). These concentrations cover the most important range for plate-out phenomena. The size distribution of the aerosol cloud covers the range 0.04 μm to about 0.3 μm, the size range for which maximum attachment of ^{222}Rn progeny to aerosol occurs. Aqueous solutions of NaCl or uranin were suggested. However, because of the corrosive effects of NaCl, aqueous solutions of uranin were used.

3. Relative Humidity and Temperature

The relative humidity values were 30%, 50%, 75% and 100%, i.e., saturation, and the temperatures were 10°C, 20° and 25°C.

4. Gamma-Radiation Field

The instrumentation to be tested was supposed to be exposed to γ-fields at the following exposure rates: 0.05 mRh^{-1}, 0.5 mRh^{-1}, 1.0 mRh^{-1}, 1.5 mRh^{-1}, and 2.5 mRh^{-1}, the latter values corresponding to the maximum permissible γ-radiation exposure level. The γ-field rates were to be administered at γ-ray energies typical of those found in uranium mines. However, practical considerations such as available source strength, radioactive half-life, and other important factors made it difficult to select the most ideal radioactive source from the above requirement standpoint, namely, γ-ray energy. Because of a number of practical difficulties and considerations only two types of radioactive sources were readily available and suitable for this study, namely, ^{137}Cs and ^{60}Co. Cesium-137 sources were selected for the evaluation of the instruments.

Calling n the number of experimental set points for each variable of interest, and using the subindices C, N, RH, T and g to indicate, respectively, ^{222}Rn progeny, aerosol concentration, relative humidity, temperature, and gamma-field, we have (see items 1 to 4 above):

$$n_C = 4,\ n_N = 2,\ n_{RH} = 4,\ n_T = 3,\ n_g = 5$$

Hence, the total number, n_T, of independent experiments that would be necessary to carry out a complete evaluation of the instrumentation of interest according to items 1 to 4 would be:

$$n_T = n_C\ n_N\ n_{RH}\ n_T\ n_g = 4 \times 2 \times 4 \times 3 \times 5 = 480$$

Even if only a maximum of one test per day were to be performed, the total number of tests, i.e., days, required to complete the evaluation would be 480 days or about 2 years! This, of course, would be very costly and extremely time-consuming. Because of time constraints, the experimental protocol was shortened substantially while still retaining the essential and important requirements and variables for an accurate and thorough technical evaluation of the instruments.

In general, the experimental procedure was as follows. Three well differentiated ^{222}Rn progeny concentration ranges were chosen to cover the overall range of practical interest, and measurements were conducted under 'normal' conditions of RH (~70%) and T (20°C) at low and moderate aerosol concentration levels with no γ-field present. This procedure was repeated for two extreme relative humidity values, keeping the temperature constant, and at three different temperatures keeping the relative humidity constant. In both cases, no γ-field was present. Finally, a set of conditions were set for the ^{222}Rn progeny concentration, aerosol concentration, relative humidity and temperature, and measurements were conducted at several γ-field exposure rates. The number of independent tests carried out was about 80.

Because the original values requested by the AECB for variables such as ^{222}Rn progeny concentration, relative humidity (RH), and temperature (T), quoted earlier, are somewhat arbitrary, efforts were not wasted in trying to attain these values with great accuracy, but rather to maintain values close enough to those requested, and hence, of the same practical use and application.

Finally, a series of tests was conducted under rapidly varying conditions of aerosol concentration and ^{222}Rn progeny concentration. These tests were followed by a number of tests under field conditions in an underground uranium mine.

DESCRIPTION OF THE INSTRUMENTATION TESTED

A brief technical description of the instrumentation tested is given below. Four instruments were evaluated, namely:

a) Two Instant Working Level Meters (IWLM), one manufactured by MDA Scientific Inc. (U.S.A.) and known as Model 811, and the other known as MIMIL IIM, designed by the Centre de Radio Protection dans les Mines (CRPM), CEA, France.

b) An automated Working Level monitor of the grab-sampling type manufactured by Pylon Electronics Development (Ottawa). The original first prototype was developed under CANMET contract and specifications (15), and known as Model WL-1000C.

c) An automated Working Level monitor of the continuous, time-integrating type manufactured by Scintrex (formerly by EDA Instruments), Toronto, originally developed by EDA under CANMET contract and specifications (20), and known as Model WLM-30.

1. THE MDA IWLM MODEL 811

The MDA-IWLM Model 811 is a light-weight (<5 kg), relatively compact (~25.4 cm x 20 cm x 7 cm), portable instrument with LED digital readout. It is battery operated using a rechargeable Ni-Cd pack, which provides adequate power for about 40 Working Level (WL) determinations. The Model 811 is housed in a heavy duty deep drawn aluminum, waterproof case with removeable protective cover and shoulder strap. An external sampling pump is used, together with a specially designed sample (filter) holder, to collect air samples on a glass fibre filter. The pump recommended for use is a battery operated double diaphragm pump with adjustable airflow rate in the range 0.5 to 3.0 L min^{-1}, manufactured by Bendix (U.S.A.). The pump is set at a flow rate of 2.5 L min^{-1}.

The IWLM Model 811 by MDA has two detectors to measure ^{222}Rn progeny radioactivity, namely, an α-particle detector (ZnS, silver activated), and a β-particle detector ('Pilot B Plastic' detector). Alpha-particle activity and β-particle activity on the sampling filter are measured simultaneously as follows. The filter/filter holder unit is inserted into a slot located between the α-particle and β-particle detectors. The sampling filter is placed with its 'active' side facing the α-particle detector to minimize α-particle absorption. Because β-particles are little absorbed by thin filter materials such as glass fibre, there is little problem for β-particles to traverse the filter material in the direction of the β-particle detector with minimum energy attenuation.

The IWLM-MDA Model 811 enables determination of the ^{222}Rn progeny Working Level, WL(Rn), in just 3.5 min from the initiation of sampling (2 min sampling at a rate of 2.5 L min^{-1}, 0.5 min interval, and 1 min counting). Alpha-particle and β-particle activity in terms of WL(Rn), electronically calculated by the circuitry, are directly given as LED digital readouts in the two independent channels. The WL(Rn) is then calculated by adding these two activities. A second determination of WL(Rn) is possible by running the instrument through a second cycle starting 0.5 min after having completed the first cycle. In order to account for the longer sample decay time the WL(Rn) obtained should be multiplied by the numerical factor 1.4 (refer to the instruction manual). The second WL(Rn) determination provides a good check on the first determination. The manufacturers claim that the instrument also enables the determination of the 'age of air' and the ^{222}Rn concentration, [^{222}Rn], in air where the sample has been taken. The age of air is determined by means of the ratio α/β (α and β here indicate the WL(Rn) readings in the α and β channels, respectively) and a graph provided in the instruction manual. The [^{222}Rn] can be calculated by building the difference α-β and using another graph given in the manual. If airflow rates other than 2.5 L min^{-1} are used, the above calculations are still valid provided the results are multiplied by the ratio 2.5/Q, where Q is the airflow rate in L min^{-1}.

In summary, the MDA IWLM-811 enables two WL(Rn) determinations on the same sample in a total time, including sampling, of 7.5 min. However, as will be shown in another section, the β-particle detector is sensitive to γ-radiation placing a serious limitation to the capabilities of the instrument. The MDA-811 has been previously evaluated by several workers (21-25).

2. THE MIMIL IIM IWLM

The MIMIL IIM, or MIMIL for short, is a light, relatively small, portable instrument designed for monitoring ^{222}Rn progeny concentration as Potential Alpha Energy Concentration, PAEC(Rn). As with the previous instrument, MDA IWLM-811, the operation of the instrument is controlled by a microprocessor which receives the signals from the counting circuits and controls the display (LCD) and execution of the sequence of instructions. The MIMIL IIM consists of two parts, namely, an air sampling pump operated at a nominal airflow rate of about 3 L min^{-1}, and the detector/counting unit. The latter uses an implanted-junction silicon detector (450 mm^2 surface area) protected by a 3 μm thick mylar membrane.

The instrument, when properly charged, can operate for about 8 hours. Recharging time is 16 h. Air samples are collected on cellulose membrane filters (1.2 μm pore size, ~28 mm diameter) held in place by means of a specially designed sample holder attached to the sampling pump by a length of plastic tubing. After air sampling, and once the filter/filter holder is introduced into the apparatus, the rest of the functions, e.g., counting and display, proceed automatically.

The MIMIL IIM uses the Rolle method (26) to calculate ^{222}Rn progeny concentration. After air sampling for a period of 2 min, and 30 s waiting time, the instrument counts for a period of 1 min (C1) followed by another α-particle count (C2) taken between 7 and 8 min after the beginning of the sampling period. The counts, C1 and C2, represent the net α-particle counts normalized to an airflow rate of 3 L min^{-1}. By extending the counting time still further, the instrument gives a value of the PAEC 12 min after the beginning of air sampling.

As a rule of thumb, the following data are of interest. If:

a) $C1 < 600$, then the $PAEC(Rn) < 10\ \mu Jm^{-3}$, and

b) $C2 > 1300$, then the $PAEC(Rn) > 10\ \mu Jm^{-3}$.

As with other instruments, including the MDA-811, the manufacturers of the MIMIL IIM claim that it is possible with their instrument to obtain ^{222}Rn concentration levels from PAEC(Rn) values. However, this is only possible if the disequilibrium factor, F, between ^{222}Rn and its progeny is known. Although the manufacturer states that F values are normally in the range 0.1 to 0.3, there are numerous cases where the values for F are well outside this narrow range. This makes the estimation of $[^{222}Rn]$ from experimental values of PAEC(Rn) and hypothetical values for F, rather uncertain and unreliable.

Because the first α-particle count, C1, is made just 2.5 min after the beginning of air sampling and only for 1 min, C1 gives a reasonable estimate of the Potential Alpha Energy Concentration due to ^{218}Po. The manufacturer of the MIMIL IIM indicates in their instruction manual that the uncertainty in estimating the above quantity is only about ±15%. The expressions given for calculating PAEC (^{218}Po) are as follows:

$$PAEC(^{218}Po) = 7.2 \times 10^{-3}\ C1 \pm 15\% \text{ for } F = 0.1 \text{ to } 0.3$$

An earlier prototype of this instrument has been evaluated at the Elliot Lake Laboratory under contract with the AECB (27,28).

3. THE PYLON WL MONITOR MODEL WL-1000C

The WL-1000C is essentially an automated, programmable, grab-sampler with α-spectroscopy capabilities. The instrument has three energy windows (i.e., channels) of width adjusted to count α-particles from ^{218}Po (6.0 MeV) and ^{212}Bi (6.1 MeV) in the first channel, and ^{214}Po (7.7 MeV) and ^{212}Po (8.8 MeV) in the second and third channels, respectively.

The instrument is divided into two main sections. The lower section contains the instrument power supply consisting of several rechargeable Ni-Cd batteries. The upper section houses a silicon-barrier α-detector as well as a microprocessor and associated electronics. Sampling of air is done by means of a sampling pump/sampling head unit connected to the upper section of the WL-1000C by means of a cable approximately 1 m in length. The instrument uses special filters mounted on plastic cards, thereby eliminating the use of tweezers and simplifying considerably the handling of samples. The WL-1000C only necessitates manual positioning of the sample, i.e., filter, in the sampling head and transfer of the sample from the sampling head to the detector system when the sampling period is over. The rest of the operational procedure is fully automatic, including the sampling period.

Several methods for determining the radiation variables of interest are programmed into the microprocessor. A total of six methods are available on command which can easily be selected by means of a keyboard. The methods are: two α-spectroscopy methods, one of the methods permits determination of the radon daughter progeny, while the second method allows the determination of radon daughter/thoron daughter mixtures; two Kusnetz methods, one of which is a shorter version of the conventional method; the Rolle method, and the Thomas-Tsivoglou method. Also available is a short calibration routine which can be used to determine the instrument's detector α-counting efficiency, ϵ, and to verify the alignment of energy discriminators for the α-spectroscopy methods.

The α-counting efficiency of the detector, ϵ, and the flow rate of the sampling pump are programmable from the keyboard. Several data are available from the instrument through a read-out unit. Those include total α-count in the energy channels, radon (thoron) daughter concentrations, and radon (thoron) daughter Working Levels. A status report on several instrument variables can also be displayed on command.

The WL-1000C is provided with a RS-232 interface output which allows transfer of data from the instrument to an external printer. In addition, the signal from the instrument, i.e., the α-spectrum of the radon and thoron progenies deposited on the filter during and/or after sampling can be studied using an external multichannel analyzer.

The WL-1000C has been described and evaluated elsewhere (15).

4. THE CONTINUOUS EDA ^{222}Rn PROGENY WORKING LEVEL MONITOR MODEL WLM-30

The WLM-30 is a compact stand-alone Working Level monitor of the continuous, time-integrating type. The instrument is microprocessor controlled by means of an 8-bit Z-80 microprocessor in conjunction with low power CMOS semiconductors throughout the electronic circuitries. The microprocessor controls all the functions of the instrument which include programmability, data storage and data retrieval. One or more WLM-30 monitors can be operated simultaneously by means of a single computer. The monitoring system is provided with a Working Level Monitor Interactive Controller Software package written in Microsoft BASIC which when loaded in an IBM PC, or compatible computer, allows the operator to fully control the operations of the WLM-30. In addition to controlling the mechanical and electronic functions of the instrument, the software package is provided with data print-out and α-particle spectrum graphic capabilities.

The WLM-30 converts the α-particle count rate measured to WL(Rn) by means of a numerical factor (in cpm WL(Rn)$^{-1}$, where cpm stands for counts per minute) which can be either input, and which value can be derived on theoretical grounds, or better still, it can be derived empirically through direct experimentation.

The WLM-30 operates at a continuous sampling rate of 1 L min^{-1}. It uses a silicon-barrier detector housed in a specially designed teflon sampling head of the quasi, in-line, type as opposed to the open face type used by the other instruments. Because of this, the instrument is susceptible to ^{222}Rn progeny plate-out on the inner and outer surfaces of the sampling head, particularly at low aerosol concentrations.

The silicon-barrier detector operates in conjunction with a spectroscopy-quality preamplifier/amplifier system which permits α-particle energy discrimination, and hence, radioisotope identification and quantification by means of α-particle spectrometric techniques.

The continuous monitor described here was designed for long-term, fully unattended operation in working locations such as underground mines and mills, tailings ponds, and the like, as well as for ^{222}Rn progeny residential monitoring.

Although the α-particle counting frequency stored in memory is programmable, a count every hour is usually what is needed for long-term monitoring. It should be noted that because the instrument operates on a continuous and time-integrating fashion, the WLM-30 has a reaction 'inertia' to changes in ^{222}Rn progeny concentration levels. In other words, the instrument cannot respond instantaneously to fast changes in ^{222}Rn progeny environmental conditions, and it lags behind by about 1 hour. Time-lag effects have to do with the nature of the growth and decay processes of radionuclides sampled through a filter at a constant rate by means of an air sampling pump, and very much depend on the radioactive half-lives of the radionuclides being sampled (7,8).

Depending on the counting frequency, the WLM-30 can operate and store data up to several months. This type of instrumentation is useful for long-term, unattended monitoring in hard to reach locations. However, aerosol filter loading may be a problem in dusty and/or aerosol laden environments.

EXPERIMENTAL CONDITIONS OF THE LABORATORY TESTS

Laboratory tests were conducted in a large (~30 m^3) Radon/Thoron Test Facility (RTTF) of the walk-in type. Experiments were carried out operating the RTTF in the recirculation mode, i.e., multiple air pass, at a recirculation percentage of 100%, and at two different airflow rates, namely, 2 m^3 min^{-1} and 4 m^3 min^{-1}.

Dry radioactive sources (^{226}Ra) of the flow through type manufactured by Pylon Electronics Development (Ottawa), model RN-1025, were used. Depending on the ^{222}Rn progeny concentration level desired and environmental conditions, such as aerosol concentration, 1 to 4 ^{226}Ra radioactive sources of ^{222}Rn were used in the tests. The activity of the sources, labelled No. 1, 2, 6, and 8, was approximately 5180 kBq (140 μCi), 3441 kBq (93 μCi), 3811 kBq (103 μCi), and 2214 kBq (59.84 μCi), respectively. In the recirculation mode the [^{222}Rn] produced in the RTTF was observed to satisfy the following ratio or relationship:

$$[^{222}Rn]/S = 0.91\ Bqm^{-3}\ kBq^{-1}\ (0.91\ pCiL^{-1}\ \mu Ci^{-1})$$

where, S is the strength of the dry ^{226}Rn source.

The range of [^{222}Rn] covered during the evaluation was from 2023 Bqm^{-3} (54.7 $pCiL^{-1}$) to 13387 Bqm^{-3} (361.8 $pCiL^{-1}$).

A summary of the conditions under which the RTTF was operated in the evaluation of the instrumentation studied is shown in Table 1. The ranges of radioactivity disequilibrium conditions, given by the following important ratios, namely: [^{214}Pb]/[^{218}Po], [^{214}Bi]/[^{218}Po], and F = (WL(Rn) x 10^2) /[^{222}Rn] are:

[^{214}Pb]/[^{218}Po] ranged from 0.1 to 0.89,

[^{214}Bi]/[^{218}Po] ranged from 0.1 to 0.83,

(WL(Rn) x 10^2)/[^{222}Rn] ranged from ~0.04 to ~0.6.

These ratios, and Table 1, indicate that the instruments of interest were tested under a wide variety of conditions ranging from relatively close radioactivity equilibrium conditions, i.e., large values for the above ratios, to high radioactivity disequilibrium conditions, i.e., low values for these ratios, for which quite a significant fraction of airborne radioactivity is removed by plate-out mechanisms on the RTTF walls and other large surfaces.

EXPERIMENTAL RESULTS AND DISCUSSION

The performance of the four instruments under evaluation, namely, the CEA MIMIL II, the Pylon WL-1000C, the EDA WLM-30, and the MDA IWLM-811 (or MDA-811) will be discussed in this section. The results corresponding to each individual instrument will be evaluated independently, and separately from the other three instruments, in the next four sections. Finally, another subsection will be devoted to a direct, parallel comparison of all the instruments. The standard method used here for determining the ^{222}Rn progeny concentration levels for testing, evaluation and calibration purposes is the Thomas-Tsivoglou method (29,30). A complete summary of the ^{222}Rn progeny data obtained by this method is given in Table 4.

A. MDA IWLM-811

Data corresponding to the MDA IWLM-811 have been summarized in Tables 2 and 3. Table 2 shows the dates and times at which measurements were carried out, as well as the following data: airflow rate at which the MDA was operated, instrument's α- and β-background counts, α- and β-readings and γ-field exposure. It should be noted that the pump supplied with the radiation instrument could not achieve the 2.5 L min^{-1} for direct Working Level, WL(Rn), readings. Depending on the day, time, and pump charging conditions, the pump flow rate,Q, ranged from ~1.5 L min^{-1} to 2 L min^{-1}. Hence, in order to compensate for this, the α- and β-counts had to be multiplied by the ratio (2.5/Q), as previously indicated, in order to calculate WL(Rn). The 'uncorrected' data are indicated in the column labelled count, alpha and beta. The corrected data, i.e., WL(Rn), are shown as WL. Because the instruments permits two radiation level determinations, the table shows Count 1 and Count 2, as well as WL(1) and WL(2), to indicate these two determinations. Also shown in Table 2 are PAEC(1) and PAEC(2) corresponding to WL(1) and WL(2), respectively. In addition, the ratio WL(1)/WL(2) is also given.

Table 3 shows the two consecutive Working Level determinations by the MDA-811, as well as their conversions to PAEC(Rn), besides WL(Rn) determinations by grab-sampling using the modified Tsivoglou (i.e., Thomas/ Tsivoglou) method (29,30). In addition, the ratios between WL(1) and WL(2) and WL(Rn), determined by the Thomas-Tsivoglou method, are also shown. Finally, the dates and times at which these measurements were carried out are also indicated. The reader should be aware that it was not always possible to make Thomas-Tsivoglou and MDA-811 measurements simultaneously because of the obvious practical difficulties and complexity of the sampling and counting scheme associated with the parallel evaluation of four different instruments, each having different characteristics, and counting and sampling time schedules. The same applies to the other instruments tested.

Table 4 shows data of general applicability to any, and each, of the instruments tested. The data in this table include daily averages for the ^{222}Rn progeny concentration level, WL(Rn) and PAEC(Rn), obtained by the Thomas-Tsivoglou method, as well as daily values for the aerosol concentration (N), temperature (T), relative humidity (RH), RTTF airflow rate (Q), and ^{222}Rn concentration, [^{222}Rn], for each test conducted.

Table 5 shows daily averages corresponding to ^{222}Rn progeny data, WL(Rn), obtained by the Thomas-Tsivoglou method and the MDA-811. Also shown in this table are the ratios of the Working Level obtained by the MDA-811 and the Thomas-Tsivoglou method, as well as a number of 'meteorological' conditions of great practical interest in the evaluation of the instrument. This table is one of the least detailed of all the tables given, but perhaps the one containing the most simplified, and at the same time valuable data from the practical standpoint for a rapid performance evaluation of the MDA-811.

Table 7 shows the important ratios WL(1)/WL(Rn) and WL(2)/WL(Rn) for the following conditions:

a) T - 21^{o}C, RH ~50%, high N ($>1.0 \times 10^{4}$ cm^{-3})

b) T - 10^{o}C, RH ~60%, low N (<500 cm^{-3})

c) T - 26^{o}C, RH ~60%, low N (<500 cm^{-3})

d) T - 20^{o}C, RH ~100%, low N (<500 cm^{-3})

e) T - 21^{o}C, RH ~50%, low N (<500 cm^{-3})

f) All experimental conditions included.

In this table, as in all other tables, WL(Rn) represents the ^{222}Rn progeny Working Level determined by the Thomas-Tsivoglou method, whereas WL(1) and WL(2) represent the ^{222}Rn progeny Working Level calculated by the MDA-811 in the first and second Working Level determinations, respectively.

Data obtained when the MDA-811 was exposed to a γ-source are shown in Table 2 (May 16-18/90). On the first two days (May 16 and 17), samples were taken from the RTTF while the instrument was located outside the RTTF and in the presence of a ^{137}Cs source. On the third day (May 18), the instrument was located inside the RTTF where the sampling was also conducted. The last column of Table 2 shows the γ-source exposure rate. Furthermore, the MDA-811 was operated for two full days (May 14-15/90) with blank filters in order to measure the instrument α- and β-backgrounds in the absence of an active, i.e., radioactive, filter.

The data in Tables 2, 5 and 6 show the following:

a) Contrary to the manufacturer's claim and the statements made in the instruction manual, the second Working Level determination by the MDA-811, i.e., WL(2), does not appear to be any more accurate than WL(1), namely, the second Working Level determination;

b) In general, there were quite significant differences between WL(1) and WL(2), which as the reader will recall pertain to two Working Level determinations of the same sample (see Table 2);

c) The overall average of all the Working Level determinations made with the

MDA-811 indicates that the instrument overestimates the Working Level by up to ~20%. For more specific experimental conditions (see Table 6), the Working Level was overestimated by up to 28%;

d) No immediate, or obvious, significant difference in the Working Level determined by the MDA-811 under a number of different experimental conditions could be ascertained (see Table 6);

e) The average value of a large number of WL(1) and (WL2) tends to indicate a slight bias in favour of WL(2), i.e., WL(2) > WL(1);

f) As predicted, and previously reported elsewhere (21-23), the MDA-811 is very susceptible to γ-radiation which can affect the instrument quite adversely (see Table 2). Negative values were frequently observed for the α- and β-background counts which often gave rise to negative values for the 'β-particle Working Level', i.e., the sample reading on the β-channel (see Table 2, days May 16-18/90). No negative values were observed for the α-channel, which suggests that the β-particle detector was affected by γ-radiation;

g) In general, the agreement between WL(1), WL(2), and WL(Rn) improved with increasing ^{222}Rn progeny concentration levels. At low WL(Rn), discrepancies between WL(1), WL(2), and WL(Rn) of up to ~70% were observed when averaged over a whole day of measurements.

A visual representation of some of the experimental data is given in Figure 1, where WL(Rn), WL(1) and WL(2) are plotted versus time. Figure 2 shows the ratios WL(1)/WL(2), WL(1)/WL(Rn), and WL(2)/WL(Rn) versus time (see Table 2).

From the data presented, the MDA-811 can be rated in general terms as reasonably good under most of the experimental conditions investigated here, except when the instrument is exposed to a γ-field. In this case, the MDA-811 is adversely affected at γ-exposure rates well below 2.5 mRh^{-1} giving unreliable, and quite often, negative results.

B. THE EDA WLM-30

Because the EDA WLM-30 is a ^{222}Rn progeny continuous monitoring system of the time-integrating type, its performance under steady-state conditions and transient conditions can be quite different. It should be noted that the terms, steady-state and transient, are applied here to radioactivity and aerosol conditions in the RTTF. When these terms are applied in a different context, the conditions under which they apply will be indicated. Such cases arise when referring to the initial growth of activity in the sampling filter shortly after turning the instrument on, or when the sampling filter is replaced while the instrument is being exposed to a radioactive atmosphere. In both cases, these experimental operations result in a transient condition in the sampling filter's radioactivity, even when sampling under constant (steady-state) radioactive and aerosol conditions. Hence, the discussion on the WLM-30 performance will be divided into two subsections corresponding to its behaviour under steady-state conditions, and transient conditions.

1. Steady-State Condition

In this case, the performance and behaviour of the instrument is studied under constant (in the RTTF) conditions of airborne ^{222}Rn progeny concentration levels and aerosol concentration. Studies under steady-state conditions are useful:

a) to investigate the effects of filter loading by high aerosol concentration levels on the instrument;

b) to determine the long-term performance of the instrument under extreme and adverse environmental conditions of say, temperature, dust or aerosol, and relative humidity, and other important factors; and

c) to calibrate the instrument taking into consideration items a) and b).

Items a) to c) have been investigated here. Some of the results are shown in Tables 7 and 8 and Figures 3 to 6.

Table 7 shows the ^{222}Rn progeny Working Level determined by the WLM-30 (indicated as Diff. WL) as well as WL(Rn), i.e., Thomas-Tsivoglou Working Level. Also shown in this table are the ratios WL(30)/WL(Rn), cpm(30)/WL(Rn), and cpm(30)/PAEC(Rn), as well as the dates and times at which samples from the RTTF were taken by the instrument and the Thomas-Tsivoglou method. The data shown in Table 7 were taken under steady-state, as well as transient conditions. An abrupt change in WL(30) and WL(Rn) is indicative of the start of a transient condition. These conditions occurred when some environmental variable in the RTTF was changed, particularly the aerosol concentration, N. Limited information on the RTTF experimental conditions can be found in Table 8. The ratio WL(30)/WL(Rn) is denoted here and in the Tables by the letter f. WL(30) and cpm(30) refer to the calculated WL and count rate from WLM-30 data.

The data of Table 8 provides insight on the performance of the EDA WLM-30 under a number of experimental conditions of interest. It also provides the calibration factors CF(Rn) and CF'(Rn) which can be programmed into the instrument's software to measure WL(Rn) and PAEC(Rn) with the required degree of accuracy. Table 8 is quite useful and careful inspection of the data in it gives the following important information:

a) The ratios f, CF(Rn), and CF'(Rn) depend on the conditions of the test, such as temperature (T), relative humidity (RH), and aerosol concentration (N).

b) The highest values for the ratios f, CF(Rn), and CF'(Rn) occur at moderate and high aerosol concentrations (i.e., $\gtrsim 2 \times 10^4$ cm^{-3}), whereas these ratios decrease with decreasing N. This clearly indicates that plate-out mechanisms are at work and are most important at low N. The reduction in cpm(30), and hence WL(30), under low N show that a significant fraction of the airborne ^{222}Rn progeny in the RTTF is in an unattached state which readily plates-out on the surface and inner conduit walls of the instrument's sample (filter) holder. This phenomenon does not occur in the determination of WL(Rn) by the Thomas-Tsivoglou method because (grab) sampling by this method is done with an open face filter whereas the WLM-30 uses a quasi in-line filter holder.

c) The lowest values for f, CF(Rn), and CF′(Rn) occurred at low RH values (12 to 16%), combined with low values of N. Hence, not only the low values of N cause ^{222}Rn progeny losses by plate-out mechanisms (see item b)), but low relative humidity conditions in the RTTF further worsen the situation because of its effect on the aerosol cloud, on the diffusivity of the ^{222}Rn progeny, and on the electrostatic condition of large surfaces. That RH plays an important role can be seen when a comparison is made between the f, and CF(Rn) values for RH = 12-16%, and RH = 93-100%, which show a significant increase in the above factors when the RH is substantially increased, i.e., from ~12% to 100%. However, it should be noted that part of the overall effect indicated is due to the slightly higher values for N(=80-340 cm^{-3}) when RH was 93-100% as compared with N = 70-150 cm^{-3} when RH ~12-16%.

It is clear from Table 8 that f, CF(Rn), and CF′(Rn) vary with T, RH and N. Hence, each new set of values for these environmental conditions will give rise to different values for f, CF(Rn), and hence, CF′(Rn). Consequently, there is no 'universal' or 'unique' calibration factor CF(Rn) applicable to all experimental conditions but rather different values of CF(Rn) for different conditions. Under field, or non-directly controllable conditions, the above poses a problem because it is not possible to choose the 'right' CF(Rn) each time that T, RH and N change, which is quite often under field conditions. This is only possible if special T, RH and N sensors are interfaced with the instrument (WLM-30) which 'sense' these variables and send, in turn, a 'message' to change CF(Rn) according to a pre-determined relationship between each set of values for T, RH and N, as shown in Table 8.

From the above discussion it may be concluded that deciding on a value for CF(Rn) for general use is not a simple matter. The overall (unweighted) average for all the experimental conditions indicated in Table 8 is:

$$\overline{CF(Rn)} = 3.71 \pm 0.65 \text{ cpm WL}^{-1}$$

If only the conditions indicated by a cross are chosen, then:

$$CF(Rn) = 3.37 \pm 0.63 \text{ cpm WL}^{-1}$$

These are the 'minimum' set of different conditions that one may want to consider of practical interest. Finally, if only one 'average' widely representative set of conditions such as T ~20%, RH ~80%, and N $\lesssim 600$ cm^{-3} (marked with two crosses) is chosen:

$$CF(Rn) = 3.98 \pm 0.63 \text{ cpm WL}^{-1}$$

The above values for CF(Rn) indicate that one should be able to determine WL(30), and hence, the 'true' Working Level, i.e., WL(Rn), within an error band of about ±18%.

A point of great interest is that of filter loading under sustained moderate aerosol conditions, i.e., in the range $2.0 \times 10^4 - 3.0 \times 10^4$ cm^{-3}. Under these conditions, the filter clogged completely after a week of continuous operation, and the flow of air through the sampling filter was interrupted because of the instrument's sampling pump failure. However, before this occurred, a significant and steady decrease in the instrument's α-particle count rate, cpm(30), could be observed (see Figure 3). Filter loading also caused a significant broadening of the α-particle spectrum (see Figure 7). A typical α-particle spectrum from the instrument is shown in Figure 8. A typical recording of the WLM-30 is shown in Figure 9, which also shows WL(Rn) for comparison purposes. Finally, Figure 10 shows a comparison of several recordings at different experimental conditions but at the same ^{222}Rn concentration level. Also shown in this figure is WL(Rn) for the purpose of comparison.

2. Transient Conditions

The EDA WLM-30 was also extensively tested under transient conditions. Transient conditions were mainly induced by changes introduced in the aerosol concentration (N) in the RTTF. The study of the behaviour of a continuous monitor of the EDA WLM-30 type is of great practical interest because these conditions arise very frequently in the field, e.g., underground mines. It will be shown that significant errors in the instrument reading may arise when the experimental data is not properly interpreted.

Figures 3, 5 and 6 show the response of the instrument under steady-state conditions in the RTTF, i.e., constant WL(Rn). The figures illustrate two typical situations, quite frequently encountered under field situations, namely:

a) The sampling filter of the instrument is replaced because of excessive aerosol and/or dust loading while the instrument is operating under steady-state environmental conditions; or

b) The instrument is subjected to a rapid change in WL(Rn), i.e., step-function, such as that occurring when the instrument is suddenly placed in the RTTF going from an atmosphere for which WL(Rn) ~0 (the laboratory room) to an atmosphere for which WL(Rn) >0 (i.e., the RTTF) in a very short period of time, or when the instrument is already in the RTTF and the WL(Rn) is suddenly increased through, for example, aerosol injection. The same applies to actual field situations.

Item a) indicates that a minimum operating time must elapse for the instrument to produce reliable, or true, results. This time is about 3-4 hours, which is the time required to attain the condition of radioactivity equilibrium in the sampling filter for which an increase in radioactivity growth in the filter is compensated by its radioactive decay.

Although the physical situation portrayed in item b) is quite different from item a), similar arguments apply equally well. It should be noted that the reverse situation also applies, i.e., a sudden decrease in WL(Rn) in the RTTF caused, for example, by a 'step-function' decrease in aerosol concentration, or the sudden removal of the instrument from the RTTF (or the field) for which WL(Rn) >0 to a location where WL(Rn) is much smaller or negligible, e.g., laboratory room. Figures 3 and 4 show, respectively, the effect of a sudden increase in aerosol concentration on the α-particle count rate and WL(30) recorded by the instrument (Figure 3), and by a sudden decrease in the aerosol concentration on the same variables (Figure 4). In both cases, N was varied in a step-function fashion. It is clear from these figures that the instrument does not react instantaneously to changes in WL(Rn) caused by changes in N. This phenomenon of 'time-lag' is well known and has been discussed by the author on numerous occasions elsewhere (7,8). The user of this type of instrument should be well aware of this behaviour or large errors may result if the data obtained are not properly interpreted.

The reader should also be aware that rapid and repeated fluctuations in WL(Rn) occurring during short periods may not be recorded by the instrument at all, or may not show clearly enough (7,8).

C. THE PYLON WORKING LEVEL METER WL-1000C

As described previously, the Pylon WL-1000C has software and hardware capabilities that allow the ^{222}Rn progeny Working Level to be determined by six different methods ranging from a fairly simple one gross α-count method to a much more complex method employing α-particle spectroscopy techniques. The method used here to evaluate the performance of the instrument, hereafter referred to as the WL-1000C for short, is a modified Kusnetz method, described elsewhere (15). The Working Level determined by the instrument by this method will be denoted WL(1000C) to differentiate it from the Working Level determined by other instruments also under evaluation, and from the modified Thomas-Tsivoglou method which is used here as the reference method. Data for the WL-1000C are summarized in Tables 9 and 10.

Table 9 shows the Working Level and PAEC determined by the Thomas-Tsivoglou method, i.e., WL(Rn), and PAEC(Rn), respectively, as well as the same variables determined by the WL-1000C, namely, WL(1000C) and PAEC(1000C).

Also shown in this table are the ratio PAEC(1000C)/PAEC(Rn), and the times and dates at which the samples were taken.

Table 10 shows the daily averages versus time and date of the following variables: WL(Rn), PAEC(Rn), WL(1000C), PAEC(1000C), and PAEC(1000C)/PAEC(Rn). (Note: the equivalence of the ratios PAEC(1000C)/PAEC(Rn) and WL(1000C)/WL(Rn) should be obvious because of the constant relationship between the Working Level, WL, and the Potential Alpha Energy Concentration, PAEC, which is: PAEC = 20.8 WL.) Also shown in Table 10 are the experimental conditions of the tests.

Figure 11 shows PAEC(1000C) and PAEC(Rn) versus date and time for direct comparison purposes. Figure 12 shows the ratio PAEC(1000C)/PAEC(Rn) versus time.

The data of Table 10 suggest that no particular set of experimental conditions gave the best performance of the instrument. The ratio of the daily average values for WL(1000C) and WL(Rn), i.e., WL(1000C)/WL(Rn), ranged from 0.8 to 1.25, although 75% of the time this ratio was in the range from 0.9 to 1.10, i.e., within approximately ±10% of the value obtained using the reference method (Thomas-Tsivoglou). In particular, the following observations are of interest:

a) High aerosol concentration, and hence low plate-out on the sampling head, did not appear to improve or influence the performance of the measurement in any significant way.

b) Transient (radiation) conditions in the RTTF, induced by changes in the aerosol concentration, did not adversely affect the performance of the instrument, i.e., the accuracy of the measurement. There are several reasons for this which also apply to other instrumentation based on grab-sampling techniques, namely:

   i) the radioactivity measurement used;
   ii) short sampling time used in the method; and

iii) absence of large radiation rate changes during the sampling period.

c) No particular reason appears immediately obvious for the ratio WL(1000C)/WL(Rn) to be >1.1 or <0.8 that can be related unambiguously to the set of values for the temperature, relative humidity, and aerosol concentration. Aerosol size distribution data did not appear to influence the performance or quality of the measurement either.

The 'overall' average value of the daily average ratio WL(1000C)/WL(Rn) i.e., the average of these daily ratios (see Table 10) over the entire period of laboratory testing was remarkably close to 1, namely 0.999 ± 0.106. However, the standard deviation (±0.106) calculated from these data clearly show that, on average, values obtained with the WL-1000C are within about ±10% of the Thomas-Tsivoglou measurements used as the measuring reference method.

The Pylon WL-1000C has a potential weak link in the system, namely, the sampling train. In particular, the user should be aware of the following items:

a) It uses a rather delicate filter system consisting of a Nuclepore^{TM} filter secured to a thin but relatively rigid 'plastic' holder. This filter system is susceptible to cracking and easy puncturing resulting in air leaks.

b) There is the danger of potential air leaks between the filter system and the filter holder used during the sampling period.

c) The sampling pump is not provided with an airflow rate measuring device such as a rotameter for airflow monitoring during the sampling period. Furthermore, there is no direct access to the exhaust of the pump. Hence, a hole had to be drilled in the sampling pump/filter holder metal case in order to connect a short length of tubing between the pump exhaust and a rotameter to monitor the sampling airflow rate.

Hence, because of items a) to c) there is a real possibility of air leaking during the sampling period, which will affect the accuracy of the results. In addition, it is not clear which way the sampling filter should be inserted into the 'slot' where a silicon barrier detector is located for α-particle counting purposes. Because the absorption of α-particles by this type of filter is relatively low, at least compared with cellulose and glass fibre materials, placing the filter 'upside down' is not immediately obvious because the α-particle activities on both sides of the filter are not so dramatically different. (It should be noted that the counting system, e.g., slot, detector, and the like, are located in the main body of the instrument itself, and not in the sampling train which is a distinctly separate item operating in conjunction with the former.)

D. THE WORKING LEVEL METER MIMIL IIM

The modified version of the original 'MIMIL' Working Level Meter prototype has been tested together with the three other instruments discussed above. The results of a technical evaluation of the first prototype (MIMIL I) have been published elsewhere (27,28). The technical evaluation of the modified prototype (MIMIL IIM) is the subject of this section.

As indicated previously, the instrument calculates the PAEC by the Rolle method (26). (It should be noted that strictly speaking, the original Rolle method calculates the Working Level. The instrument under consideration here follows this method to calculate the Working Level and then converts this value to PAEC according to the well known relationship PAEC = 20.8 WL.) To distinguish the data given by the MIMIL IIM from the data given by the other instruments, the PAEC displayed by the instrument will be denoted PAEC(M), and our calculation of the Working Level based on PAEC(M) will be denoted WL(M). A summary of the data obtained with the instrument is shown in Tables 11 to 13 and Figures 13 and 14.

Table 11 shows the instrument's 'background' count, the three α-particle counts registered by the instrument to calculate the data of interest, denoted C1, C2 and C3, and the PAEC(M). Also shown in the table is the conversion WL(M) = PAEC(M)/20.8, and the date and time at which the samples were taken.

Table 12 shows PAEC(M), WL(M) as well as the same variables calculated by the reference method used (Thomas-Tsivoglou), namely PAEC(Rn) and WL(Rn). Also shown in the Table are the 'performance' ratio PAEC(M)/PAEC(Rn), and the dates and times at which the samples were taken.

Table 13 shows the daily averages for WL(Rn), PAEC(Rn), WL(M), PAEC(M), and the ratio PAEC(M)/PAEC(Rn). Also shown in the table are the dates of the measurements and the experimental conditions (T, RH and N) under which the evaluations were conducted.

Figure 13 shows PAEC(Rn) and PAEC(M) versus date and time for comparison purposes. Figure 14 shows PAEC(M)/PAEC(Rn) versus date and time.

The data in Table 13 shows that in about 50% of the cases the ratio PAEC(M)/PAEC(Rn) fell outside the range 0.9 to 1.1, and was in most of the cases significantly higher than unity. The 'overall' average of the daily averages for this ratio was 1.08 ± 0.11, which indicates that on average the instrument overestimates the ^{222}Rn progeny concentration level by approximately 8%. Furthermore, similar arguments to those outlined in the evaluation of the WL-1000C apply also, namely:

a) 'High' aerosol concentration, and hence, minimum ^{222}Rn progeny plate-out on the instrument's sampling head did not improve the ratio PAEC(M)/PAEC(Rn). On the contrary, under high aerosol concentration levels, the average value for this ratio was significantly higher (1.16 ± 0.04) than the 'overall' average of all the daily averages combined, i.e., 1.08 ± 0.11.

b) Transient radiation conditions did not have any effect significantly different on the ratio PAEC(M)/PAEC(Rn) than any other particular experimental condition.

c) In general, no biasing of the results could be observed that were related to any set of environmental factors.

The MIMIL IIM could benefit from some simple but obvious improvements such as the addition of a rotameter in series with the sampling pump in order to monitor the sampling airflow rate. Furthermore, it is still surprising to find that the filter holder has no filter backup to better support the sampling filter in place. This was noticed in the first MIMIL prototype and the lack of such a backup could introduce mechanical problems which should not arise. For example, the filter can break easily by simple percussion. A further complication could occur in the sampling train because the MIMIL's sampling pump is susceptible to airflow rate resonance effects, which depend on the intake tubing length connecting the filter/filter holder system to the air sampling pump. This phenomenon was reported in the technical evaluation of an earlier MIMIL model, namely the MIMIL I (27,28). More recently, a thorough study on resonance phenomena has clearly shown that all the pumps tested in this study exhibited a significant degree of resonance, particularly at the exhaust site (31).

A few other items on the performance of the MIMIL IIM were noticed:

a) Occasional high background, the effect of which on the PAEC(M) is not immediately obvious.

b) The 'low battery' indicator of the instrument, i.e., the scaler, was showing that the charge on the scaler's battery pack was low even after only a few samples had been taken and the battery pack had been on charge overnight.

c) If measurements were not carried out at times $\gtrsim 20$ min after removal of the previous sample, the background reading shown by the instrument tended to be higher than 'normal'. Hence, a minimum 'waiting' period was necessary between sample measurements for 'confident' results. This background effect could be caused by ^{222}Rn progeny desorption from the filter material followed by plate-out on the detector.

COMPARISON OF DIFFERENT INSTRUMENTS

In the four previous sections, a summary analysis has been presented of the data obtained with the four instruments under technical evaluation. However, the analysis for each instrument has been presented independently. In this section, some of the data pertaining to each of the four instruments evaluated in the laboratory are discussed and compared with one another. Table 14 shows two ratios of practical interest which gives information about the individual performance of each instrument, namely the ratios PAEC(X)/PAEC(Rn) and P(X).

PAEC(X)/PAEC(Rn) has already been introduced, and its meaning has been discussed in the text and in other previous tables. However, its definition will be repeated here to facilitate the discussion. This ratio gives a measure of the 'deviation' of the PAEC measured by a given instrument and method which is different from the Thomas-Tsivoglou grab-sampling method used here as the standard or reference method of measurement. In this sense, the ratio PAEC(X)/PAEC(Rn) can be considered (within certain obvious statistical limitations) to provide an index of instrument and/or method 'performance'. In this ratio the letter X is used to identify the instrument and/or method used in the determination of the PAEC, e.g., PAEC(M) indicates that the PAEC has been determined by means of the MIMIL IIM. As usual, the use of the symbol Rn is restricted to indicate the PAEC or WL determined by the Thomas-Tsivoglou method.

The ratio (symbol) P(X) is used to indicate the percentage ratio of the standard deviation of F(X) = PAEC(X)/PAEC(Rn), i.e., SD(X), to F(X), i.e., P(X) = SD(X)/F(X). For example, P for the Pylon WL-1000C, will be, P(1000C) = (0.106/0.999) x 10^2 = 10.6, and so on.

It is important to note that the values for the ratios F(X) (=PAEC(X)/PAEC(Rn)) represent 'overall' averages of all the daily averages obtained for these ratios, for each instrument, during the entire experimental evaluation period. Finally, the values given for the temperature (T), relative humidity (RH), and aerosol concentration (N), represent the entire range of experimental values attained for these variables during the evaluation period, as indicated in Table 14.

Judging from the straightforward and elementary arguments presented in Table 14, the 'best performers' according to this simplistic 'first order approximation', statistical analysis are:

1. Pylon WL-1000C
2. MIMIL IIM
3. EDA WLM-30
4. MDA IWLM-811.

However, the above are not the only criteria on which to decide on the best 'overall' performance because other factors have to be considered, such as:

a) Portability of the instrument,
b) Complexity of the method/instrument which partly defines its practical usefulness,
c) Data accessibility,
d) Reliability (electronic and mechanical),
e) Number of samples that can be taken without recharging the battery (power pack).
f) Susceptibility to environmental conditions,
g) Ruggedness,
h) 'Tolerance' to dusty and humid conditions,
i) Other considerations.

Because, as explained below, the underground evaluation was a limited one and not all the instruments were tested under underground conditions, some of the above items cannot be ascertained. However, the present laboratory evaluation has been thorough enough, and the environmental conditions to which the instruments were exposed sufficiently hostile and for fairly extended periods of time that some of the unknown factors can be answered with a certain degree of confidence. Furthermore, some of these instruments, or earlier prototypes of these instruments, have been previously used and/or evaluated underground by the Elliot Lake Laboratory.

The four instruments evaluated have been ranked according to some of items a) to i) outlined above. The performance of the instrument to the several instrument 'qualifiers' is ranked as 0 (less than fair), 1 (fair), and 2 (good). The total score is obtained by adding the individual scores for each instrument for the several 'qualifiers' used. The instrument with the highest score is the best performer. The qualifiers selected are the following: Portability, simplicity of operation, accessibility of the data, flexibility (e.g., if more than one method of measurement is available), 'resistance' to hostile environmental conditions, and ruggedness. Table 15 shows the score given to the different instruments.

Table 15 shows the MIMIL IIM, the Pylon WL-1000C, and the MDA-811 clearly superior to the EDA WLM-30. However, this is not a fair comparison because in this case the operating principles and the application of the WLM-30 is somewhat different from that of the three grab-samplers. However, the closeness of the MDA IWLM-811, Pylon WL-1000C and the MIMIL IIM 'fades' when the data of Table 14 is taken into account as the performance of the MDA-811 cannot be considered satisfactory. First, this instrument gave the largest value for F and P. Second, the MDA-811 has proved to be very susceptible to γ-radiation. On these two accounts, the best two 'overall' performers are the Pylon WL-1000C and the MIMIL IIM. The former out-performed the latter in flexibility (it has the capability to measure ^{222}Rn progeny by six different methods. Furthermore, it also enables determination of ^{220}Rn progeny), and accuracy. However, the MIMIL IIM is conceptually simpler, the data is easier to retrieve (automatic display after the measurement is over), the method used

(Rolle) is faster, and the instrument is more portable than the WL-1000C.

From the above discussion and taking into consideration that the main application of the instruments evaluated is for the fast determination of the ^{222}Rn progeny Working Level (or PAEC) by mine ventilation personnel and AECB uranium mine inspectors, it would appear that the best 'overall' performance taking all the advantages and disadvantages into account (i.e., Tables 14 and 15) is the MIMIL IIM.

As previously pointed out, a serious drawback of the instruments tested is the lack of a flowmeter device built-in the instrument to monitor the airflow rate during the sampling period. The only exception to this was the MDA-811, for which a pump is provided with a rotameter for airflow monitoring. However, it should be noted that the pump used in conjunction with the MDA-811 is not manufactured or provided by this company but the company only recommends its use.

UNDERGROUND EVALUATION OF THE INSTRUMENTS

A full underground evaluation of the four instruments tested under laboratory controlled conditions could not be conducted because of the imminent closing down of several underground uranium mines in the Elliot Lake area, locations where the evaluation was to be performed. Hence, only a limited evaluation was conducted in several working locations at one of the mines. Furthermore, because of other practical difficulties not all the instruments could be tested. For example, the EDA WLM-30, which requires alternating current (AC, 117 V) for its operation, was not taken underground because the mine locations where arrangements were made for the technical evaluation had no 117 V AC, and no provisions were made by mine personnel to install electrical power in these test locations. In addition, the Pylon WL-1000C was not taken underground either because it had been previously evaluated in uranium mines by the Elliot Lake Laboratory on several occasions.

Finally, and despite the poor past performance of the MDA-811 in underground uranium mines (21-23), this instrument was taken as well as the MIMIL IIM for a limited field evaluation. What follows is a short account of the data obtained.

UNDERGROUND EXPERIMENTAL RESULTS AND DISCUSSION

The underground evaluation could not be extended beyond four full working day shifts. The MIMIL IIM could be tested during the entire duration of the underground evaluation, whereas because of practical difficulties, the MDA-811 was tested for three days. Furthermore, and because of time limitation during the working day shifts, the Thomas-Tsivoglou method could not always be used. On average, two determinations by this method could be carried out, the rest of the reference measurements were conducted using the modified Kusnetz method. Two mine drifts and one production stope were selected for the measurements. The radiation conditions in these locations, measured by the reference method(s), are shown in Table 16.

Table 16 shows that the ^{222}Rn progeny Working Level and PAEC underground were about 0.2 and 4.5 μJm^{-3}, respectively. Depending on ventilation conditions, the disequilibrium ratios $[^{214}Pb]/[^{218}Po]$ and $[^{214}Bi]/[^{218}Po]$ ranged respectively, from ~0.36 and 0.7, and from 0.16 to 0.5. Temperature and relative humidity were in the following ranges: T = 14.6 to 17.7°C and RH = 83 to 92%. All these experimental conditions were covered during the technical evaluation conducted in the Radon/Thoron Test Facility (RTTF), i.e., the laboratory evaluation under controlled conditions.

Tables 17 and 18 give data for the MDA-811 and MIMIL IIM, respectively. Also given, for comparison purposes, are the measurements carried out with the radiation reference method, and the important ratio F(X) = WL(X)/WL(Rn) = PAEC(X)/PAEC(Rn).

Table 19 gives the daily average values for some of the above variables. Finally, Table 20 gives the ratios F(X) and P(X), defined earlier, for the two instruments.

Taking the combined performance of the instruments, as rated according to the ratio F(X) - PAEC(X)/PAEC(Rn), Table 20 shows that the MDA-811 underestimated the ^{222}Rn progeny concentration level by about 10%, whereas the MIMIL IIM overestimated the same variable by the same amount. The latter value is consistent with data obtained during the laboratory evaluation, namely, F(M) - 1.08 ± 0.11 (see Table 14). The value for the same ratio for the MDA-811 does not agree, however, with the results obtained in the laboratory evaluation. It should be noted, however, that the effect of the γ-field to which the MDA-811 is exposed during the underground measurements should be considered to have a major disrupting effect as demonstrated in the laboratory tests. It is not clear whether the presence of a γ-field induces an increase or a decrease in the β-channel reading of the instrument because not enough laboratory data are available at present to decide one way or the other. Hence, for lack of better or more information it will be assumed:

a) The γ-field affects the reading on the MDA-811 β-channel in a purely 'non-directional' fashion.

b) The 'direction' of influence may depend on the strength of the γ-field. This contention may partly be supported by the data shown in Table 5.

Another important consideration in the field evaluation of the two instruments under consideration is that it was not always possible to use the modified Thomas-Tsivoglou method as the standard reference method for comparison purposes for the reasons alluded to before.

Finally, taking into account the discussion on the instrument evaluations under laboratory-controlled conditions, the tests under field conditions outlined above, and the fact that $P(M) < P(1)$ and $P(M) < P(2)$, one may conclude that the performance of the MIMIL IIM was significantly better and more consistent than that of the MDA-811.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A technical evaluation has been conducted on four instruments of common use in the field and the laboratory for the measurement of airborne ^{222}Rn progeny concentration. The evaluation was carried out under laboratory-controlled conditions, and under field conditions at several mine locations in an underground uranium mine.

The evaluation of the instrumentation of interest consisted of a thorough laboratory study on the performance and behaviour of the instruments under a wide variety of environmental conditions most likely, or known, to be encountered in real life situations. A limited field evaluation followed the laboratory evaluation.

Radon-222 progeny measurements by the four instruments tested (in terms or units of Potential Alpha Energy Concentration, PAEC, or Working Level, WL) were compared with a widely accepted reference method, namely, the Thomas-Tsivoglou method. The instruments were rated according to several criteria such as:

1. Accuracy of measurement as compared with the reference method.
2. Response of the instruments exposed to ^{222}Rn progeny concentrations in the range WL(Rn) = 0.02 to 1.4, i.e., up to a 70-fold increase in WL(Rn), or PAEC(Rn).
3. Response of the instruments under a wide variety of temperature, relative humidity, aerosol concentration, dust concentration, and airflow conditions.
4. Portability and ruggedness.
5. Simplicity of the radioactivity measurement method used, minimum time required for the sampling and counting procedure, and simplicity of operation and data retrieval.
6. Radioactivity measurements flexibility, i.e., if the instrument permits more than one method to be used, such as the Pylon WL-1000C.

Except for the MDA-811, which was quite susceptible to γ-field exposure, and the EDA WLM-30 which was sensitive to filter loading, all the instruments responded in a similar fashion to a variety of environmental conditions. Because the EDA WLM-30 is a 'time-integrating' continuous monitor which requires a personal computer to be operated for data retrieval, this instrument must be placed in a different category altogether, and separated from the other three instruments which operate on grab-sampling principles. Furthermore, the EDA WLM-30, requires an external source of electrical power to operate it, and as with any continuous monitor of the time-integrating type, it responds slowly to fast changes in ^{222}Rn progeny concentration, and takes a relatively long time for radioactivity on the filter to attain steady-state conditions when the instrument is first started. For these reasons, the EDA WLM-30 has been eliminated from the comparison with the other three instruments, and its use is recommended for long-term site monitoring.

From the standpoint of portability, ease of operation, simplicity of data retrieval, and minimum time required for the combined sampling and counting operations, the MDA-811 and the MIMIL IIM emerged as the two top contenders. From the 'accuracy' standpoint, flexibility, and 'indifference' to γ-field exposure, the Pylon 1000C should be rated first, followed by the MIMIL IIM. However, when taking all the factors into consideration, it would appear that the MIMIL IIM offers the best overall performance. It should be noted, however, that some improvements could be introduced into the instrument, such as an in-line rotameter to monitor the pump airflow rate, and a filter back-up to better support the sampling filter. Furthermore, it seems that under certain operating conditions, the sampling pump can exhibit resonance effects. Finally, a frequent weak battery pack condition has been noticed even with a fully charged battery, i.e., battery pack being charged overnight.

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Table 1 - Temperature (T), relative humidity (RH), γ-field exposure rate (γ-rate), and range of other conditions covered during the operation of the RTTF.

T (^{o}C)	RH (%)	γ-Rate (mRh^{-1})	[^{222}Rn] (Bqm^{-3})	WL(Rn)	PAEC(Rn) (μJm^{-3})	N* (cm^{-3})
10,20,25	10,15,25 50,70,75, 95	0.05, 0.5, 1.0,1,5, 2.5	2023-13887	0.016- 1.38	0.33-28.7	$\lesssim$100-3x10^4

* N stands for aerosol concentration.

Table 2 - MDA-811 data.

MDA

Date	Time	Flowrate	Back ground 1		Count 1		Back ground 2		Count 2		WL(1)	PAEC.(1)	WL(2)	PAEC.(2)	WL(1) / WL(2)	Gamma field mR/h
		L/min	alpha	beta	alpha	beta	alpha	beta	alpha	beta		uJ/m3		uJ/m3		
Mar 19 90	1108	1.54	0		0.03	0.01	0		0.02	0.02	0.06	1.35	0.09	1.89	0.71	
	1307	1.54	0.01		0.02	0.02	0		0.01	0.02	0.06	1.35	0.07	1.42	0.95	
Mar 20 90	807	1.54	0.01		0.01	0.01	0.01		0.04	0.04	0.03	0.68	0.16	3.78	0.18	
	903	1.54	0		0.03	0	0.01		0.01	0.02	0.05	1.01	0.07	1.42	0.71	
	1033	1.54	0		0.03	0.01	0		0.02	0.03	0.06	1.35	0.11	2.36	0.57	
	1121	1.54	0.01		0.03	0.02	0		0.01	0.02	0.08	1.69	0.07	1.42	1.19	
	1258	1.54	0.01		0.02	0	0		0.01	0.03	0.03	0.68	0.09	1.89	0.36	
	1344	1.54	0		0.03	0.03	0		0.01	0.01	0.10	2.03	0.05	0.95	2.14	
	1420	1.54	0.01		0.02	0.01	0		0.02	0.02	0.05	1.01	0.09	1.89	0.54	
Mar 21 90	815	1.54	0.01		0.02	0.02	0.01		0.01	0.02	0.06	1.35	0.07	1.42	0.95	
	901	1.54	0.01		0.02	0.02	0.01		0.01	0.01	0.08	1.69	0.05	0.95	1.79	
	1410	1.54	0.01		0.03	0.03	0.01		0.01	0.01	0.10	2.03	0.05	0.95	2.14	
	1525	1.54	0		0.02	0.02	0		0.02	0.01	0.06	1.35	0.07	1.42	0.95	
Mar 22 90	818	1.54	0		0.03	0	0		0.02	0.01	0.05	1.01	0.07	1.42	0.71	
	856	1.54	0		0.03	0.01	0.01		0.01	0.02	0.06	1.35	0.07	1.42	0.95	
	924	1.54	0		0.05	0.04	0		0.03	0.04	0.15	3.04	0.16	3.31	0.92	
	1040	1.54	0		0.04	0.04	0		0.03	0.04	0.13	2.70	0.16	3.31	0.82	
	1116	1.54	0		0.05	0.03	0		0.03	0.04	0.13	2.70	0.16	3.31	0.82	
	1254	1.54	0		0.05	0.04	0		0.03	0.02	0.15	3.04	0.11	2.36	1.29	
	1355	1.54	0		0.05	0.05	0		0.03	0.01	0.16	3.38	0.09	1.89	1.79	
	1425	1.54	0		0.04	0.04	0		0.05	0.02	0.13	2.70	0.16	3.31	0.82	
	1530	1.54	0		0.04	0.01	0.01		0.01	0.01	0.08	1.69	0.05	0.95	1.79	
Mar 23 90	809	1.54	0		0.03	0	0		0.01	0.02	0.05	1.01	0.07	1.42	0.71	
	846	1.54	0		0.02	0.04	0.01		0	0.02	0.10	2.03	0.05	0.95	2.14	
	919	1.54	0.01		0.01	0.03	0.01		0	0.03	0.06	1.35	0.07	1.42	0.95	
	1026	1.54	0.01		0.02	0.01	0.01		0	0.04	0.05	1.01	0.09	1.89	0.54	
	1229	1.54	0		0.04	0.02	0		0.01	0.02	0.11	2.36	0.07	1.42	1.67	
	1307	1.54	0.01		0.02	0.03	0		0.02	0.01	0.08	1.69	0.07	1.42	1.19	
	1338	1.54	0		0.04	0	0.01		0	0	0.06	1.35	0.00	0.00	ERR	
	1428	1.54	0		0.04	0.03	0		0.01	0	0.11	2.36	0.02	0.47	5.00	
Mar 26 90	813	1.54	0.01		0.02	0.03	0.01		0	0.03	0.08	1.69	0.07	1.42	1.19	
	850	1.54	0		0.02	0	0		0.01	0	0.03	0.68	0.02	0.47	1.43	
	925	1.54	0		0.04	0.03	0		0.01	0.01	0.11	2.36	0.05	0.95	2.50	
	1030	1.54	0		0.03	0.01	0.01		0	0	0.06	1.35	0.00	0.00	ERR	
	1106	1.54	0.01		0.01	0.01	0		0.02	0.01	0.03	0.68	0.07	1.42	0.48	
	1258	1.54	0		0.03	0.01	0		0.01	0.03	0.06	1.35	0.09	1.89	0.71	
	1332	1.54	0		0.03	0.01	0		0.01	0.01	0.06	1.35	0.05	0.95	1.43	
	1413	1.54	0		0.01	0.01	0.02		0.01	0.01	0.03	0.68	0.05	0.95	0.71	
Apr 03 90	811	1.54	0		0.04	0.01	0.01		0	0.01	0.08	1.69	0.02	0.47	3.57	
	859	1.54	0.01		0.02	0.02	0		0.02	0	0.06	1.35	0.05	0.95	1.43	
	929	1.54	0		0.08	0.05	0.01		0.03	0.06	0.21	4.39	0.20	4.25	1.03	
	1046	1.54	0		0.16	0.12	0		0.09	0.09	0.45	9.45	0.41	8.51	1.11	
	1122	1.54	0		-0.89	0.15	0		0.1	0.11	-1.20	-24.99	0.48	9.93	-2.52	
	1346	1.54	0.01		0.11	0.12	0.01				0.37	7.77	0.00	0.00	ERR	
	1421	1.54	0		0.14	0.16	0		0.08	0.13	0.49	10.13	0.48	9.93	1.02	
Apr 04 90	821	1.54	0		0.16	0.17	0.01		0.09	0.14	0.54	11.14	0.52	10.87	1.02	
	901	1.54	0.01		0.11	0.14	0		0.11	0.15	0.41	8.44	0.59	12.29	0.69	
	1029	1.54	0		0.11	0.1	0.01		0.08	0.13	0.34	7.09	0.48	9.93	0.71	
	1106	1.54	0		0.13	0.14	0		0.11	0.15	0.44	9.12	0.59	12.29	0.74	
	1306	1.54	0		0.12	0.15	0		0.12	0.15	0.44	9.12	0.61	12.76	0.71	
	1334	1.54	0.01		0.14	0.19	0		0.11	0.14	0.54	11.14	0.57	11.82	0.94	

Cont.

Table 2 - cont.

	1416	1.54	0	0.12	0.13	0.01	0.09	0.17	0.41	8.44	0.59	12.29	0.69
	1530	1.54	0.01	0.13	0.12	0	0.11	0.15	0.41	8.44	0.59	12.29	0.69
Apr 05 90	812	1.54	0	0.12	0.19	0	0.12	0.16	0.50	10.47	0.64	13.24	0.79
	848	1.54	0.02	0.13	0.14	0	0.1	0.18	0.44	9.12	0.64	13.24	0.69
	926	1.54	0.01	0.12	0.16	0.01	0.12	0.2	0.45	9.45	0.73	15.13	0.63
	1032	1.54	0.19	-0.05	0.14	0	0.1	0.14	0.15	3.04	0.55	11.35	0.27
	1114	1.54	0	0.15	0.18	0	0.1	0.15	0.54	11.14	0.57	11.82	0.94
	1258	1.54	0.01	0.15	0.19	0	0.11	0.14	0.55	11.48	0.57	11.82	0.97
	1333	1.54	0.01	0.16	0.16	0	0.11	0.11	0.52	10.81	0.50	10.40	1.04
	1418	1.54	0.01	0.16	0.13	0	0.11	0.13	0.47	9.79	0.55	11.35	0.86
Apr 06 90	811	1.54	0.01	0.14	0.2	0.01	0.09	0.14	0.55	11.48	0.52	10.87	1.06
	846	1.54	0	0.17	0.19	0.01	0.09	0.15	0.58	12.16	0.55	11.35	1.07
	921	1.54	0	0.14	0.2	0.01	0.13	0.17	0.55	11.48	0.68	14.18	0.81
	1038	1.54	0	0.12	0.16	0	0.1	0.15	0.45	9.45	0.57	11.82	0.80
	1112	1.54	0.01	0.11	0.14	0.01	0.1	0.15	0.41	8.44	0.57	11.82	0.71
	1254	1.54	0.01	0.14	0.19	0.01	0.09	0.13	0.54	11.14	0.50	10.40	1.07
	1337	1.54	0	-0.85	0.15	0	0.13	0.17	-1.14	-23.64	0.68	14.18	-1.67
	1412	1.54	0	0.14	0.15	0.01	0.09	0.16	0.47	9.79	0.57	11.82	0.83
Apr 09 90	1126	1.54	0.01	0.21	0.21	0.01	0.12	0.15	0.65	14.18	0.61	12.76	1.11
	1257	1.54	0.01	0.39	0.39	0.01	0.26	0.37	1.27	26.34	1.43	29.78	0.88
	1330	1.54	0.01	0.37	0.4	0	0.28	0.37	1.25	26.00	1.48	30.73	0.85
	1414	1.54	0	0.36	0.38	0.01	0.24	0.37	1.20	24.99	1.39	28.84	0.87
90	920	1.54	0	0.34	0.39	0.01	0.24	0.42	1.19	24.65	1.50	31.20	0.79
	1027	1.54	0.01	0.37	0.39	0	0.24	0.37	1.23	25.66	1.39	28.84	0.89
	1101	1.54	0.01	0.35	0.36	0.01	0.22	0.37	1.15	23.97	1.34	27.89	0.86
	1253	1.54	0	0.36	0.39	0.01	0.24	0.39	1.22	25.32	1.43	29.78	0.85
	1332	1.54	0	0.34	0.37	0	0.23	0.35	1.15	23.97	1.32	27.42	0.87
	1423	1.54	0	0.35	0.39	0	0.25	0.4	1.20	24.99	1.48	30.73	0.81
	1536	1.54	0	0.34	0.43	0	0.26	0.42	1.25	26.00	1.55	32.15	0.81
	1707	1.54	0	0.43	0.44	0	0.28	0.39	1.41	29.38	1.50	31.20	0.94
	1741	1.54	0	0.37	0.43	0.01	0.26	0.4	1.30	27.01	1.50	31.20	0.87
	1816	1.54	0.01	0.31	0.39	0	0.28	0.4	1.14	23.64	1.55	32.15	0.74
	1849	1.54	0	0.35	0.36	0.01	0.23	0.33	1.15	23.97	1.27	26.47	0.91
	1922	1.89	0.01	0.45	0.42	0.01	0.3	0.51	1.15	23.94	1.50	31.20	0.77
	1957	1.89	0.01	0.4	0.51	0	0.32	0.51	1.20	25.04	1.54	31.97	0.78
Apr 11 90	811	1.9	0	0.46	0.52	0	0.34	0.51	1.29	26.82	1.57	32.57	0.82
	845	1.9	0	0.45	0.47	0	0.32	0.5	1.21	25.18	1.51	31.42	0.80
	925	1.9	0	0.46	0.49	0	0.32	0.53	1.25	26.00	1.57	32.57	0.80
	1032	1.9	0	0.43	0.55	0	0.31	0.45	1.29	26.82	1.40	29.12	0.92
	1105	1.9	0.01	0.43	0.6	0	0.33	0.54	1.36	28.19	1.60	33.33	0.85
	1526	1.9	0.01	0.43	0.51	0.01	0.34	0.5	1.24	25.73	1.55	32.19	0.80
	1329	1.9	0	0.46	0.51	0	0.33	0.5	1.28	26.55	1.53	31.80	0.83
	1401	1.9	0	0.51	0.53	0.01	0.31	0.51	1.37	28.46	1.51	31.42	0.91
	1434	1.9	0	0.49	0.54	0.01	0.35	0.47	1.36	28.19	1.51	31.42	0.90
Apr 12 90	807	1.9	0	0.53	0.57	0	0.33	0.55	1.45	30.11	1.62	33.72	0.89
	840	1.9	0.02	0.49	0.52	0	0.33	0.5	1.33	27.64	1.53	31.80	0.87
	919	1.9	0.01	0.47	0.58	0.01	0.33	0.56	1.38	28.74	1.64	34.10	0.84
	1038	1.9	0.01	0.42	0.5	0.01	0.35	0.54	1.21	25.18	1.64	34.10	0.74
	1111	1.9	0	0.52	0.53	0.01	0.3	0.55	1.38	28.74	1.57	32.57	0.88
Apr 18 90	751	2	0.01	0.1	0.05	0.01	0.06	0.03	0.19	3.90	0.16	3.28	1.19
	829	2	0.01	0.09	0	0	0.03	0.08	0.11	2.34	0.19	4.00	0.58
	904	2	0	0.11	0.06	0	0.05	0.05	0.21	4.42	0.18	3.64	1.21
	946	2	0	0.1	0.15	0.01	0.07	0.07	0.31	6.50	0.25	5.10	1.28
	1032	2	0.19	0.09	0.07	0.01	0.04	0.06	0.20	4.16	0.18	3.64	1.14
	1104	2	0	0.11	0.09	0	0.06	0.02	0.25	5.20	0.14	2.91	1.79
	1134	2	0	0.1	0.05	0.01	0.03	0.02	0.19	3.90	0.09	1.82	2.14

Cont.

Table 2 - cont.

	1303	2	0	0.1	0.04	0	0.05	0.03	0.18	3.64	0.14	2.91	1.25
	1340	2	0	0.1	0.03	0	0.06	0.07	0.16	3.38	0.23	4.73	0.71
	1416	2	0.01	0.11	0.04	0.01	0.04	0.04	0.19	3.90	0.14	2.91	1.34
Apr 19 90	814	2	0.01	0.13	0.08	0	0.06	0.02	0.26	5.46	0.14	2.91	1.88
	850	2	0	0.13	0.05	0	0.06	0.07	0.23	4.68	0.23	4.73	0.99
	923	2	0	-0.88	0.06	0	0.05	0.05	-1.03	-21.32	0.18	3.64	-5.86
	1102	2	0.01	0.1	0.08	0	0.08	0.09	0.23	4.68	0.30	6.19	0.76
	1132	2	0	0.06	0.02	0	0.03	0.03	0.10	2.08	0.11	2.18	0.95
	1240	2	0	0.16	0.14	0	0.1	0.15	0.38	7.80	0.44	9.10	0.86
	1320	2	0	0.16	0.13	0.01	0.08	0.1	0.36	7.54	0.32	6.55	1.15
	1351	2	0	0.14	0.12	0	0.1	0.07	0.33	6.76	0.30	6.19	1.09
	1426	2	0.01	0.12	0.1	0	0.11	0.12	0.28	5.72	0.40	8.37	0.68
Apr 20 90	823	2	0	0.15	0.12	0	-0.91	0.12	0.34	7.02	-1.38	-28.76	-0.24
	853	2	0.01	0.15	0.11	0	0.08	0.12	0.33	6.76	0.35	7.28	0.93
	927	2	0.01	0.12	0.09	0	0.09	0.11	0.26	5.46	0.35	7.28	0.75
	1031	2	0	0.12	0.1	0.01	0.05	0.11	0.28	5.72	0.28	5.82	0.98
	1115	2	0	0.15	0.08	0	0.08	0.15	0.29	5.98	0.40	8.37	0.71
	1256	2	0	0.16	0.14	0	0.08	0.1	0.38	7.80	0.32	6.55	1.19
	1404	2	0	0.15	0.04	0	0.09	0.08	0.24	4.94	0.30	6.19	0.80
	1533	2	0.01	0.15	0.11	0.01	0.1	0.11	0.33	6.76	0.37	7.64	0.88
Apr 23 90	1306	2	0	0.13	0.06	0	0.07	0.06	0.24	4.94	0.23	4.73	1.04
	1338	2	0.01	0.11	0.08	0	0.1	0.06	0.24	4.94	0.28	5.82	0.85
	1412	2	0.02	0.12	0.07	0	0.07	0.07	0.24	4.94	0.25	5.10	0.97
	1449	2	0.01	0.13	0.07	-0.19	0.09	0.12	0.25	5.20	0.37	7.64	0.68
Apr 24 90	818	2	0	0.17	0.09	0	0.09	0.12	0.33	6.76	0.37	7.64	0.88
	902	2	0.01	0.16	0.12	0	0.09	0.13	0.35	7.28	0.39	8.01	0.91
	1022	2	0	0.17	0.12	0	0.11	0.1	0.36	7.54	0.37	7.64	0.99
	1055	2	0.01	0.15	0.12	0	0.09	0.1	0.34	7.02	0.33	6.92	1.02
	1128	2	0	0.18	0.11	0	0.11	0.13	0.36	7.54	0.42	8.74	0.86
	1303	2	0	0.16	0.13	0	0.12	0.17	0.36	7.54	0.51	10.56	0.71
	1340	2	0	0.17	0.16	0.01	0.1	0.15	0.41	8.58	0.44	9.10	0.94
	1419	2	0	0.19	0.17	0	0.1	0.16	0.45	9.36	0.46	9.46	0.99
Apr 25 90	812	2	0	0.21	0.16	0	0.12	0.14	0.46	9.62	0.46	9.46	1.02
	848	2	0.01	0.18	0.18	0	0.12	0.15	0.45	9.36	0.47	9.83	0.95
	922	2	0.01	0.17	0.13	0.01	0.13	0.13	0.38	7.80	0.46	9.46	0.82
	1041	2	0	0.18	0.15	0.02	0.09	0.17	0.41	8.58	0.46	9.46	0.91
	1123	2	0.01	0.21	0.15	0.01	0.09	0.12	0.45	9.36	0.37	7.64	1.22
	1259	2	0.01	0.15	0.13	0.01	0.1	0.13	0.35	7.28	0.40	8.37	0.87
	1336	2	0.01	0.17	0.13	0	0.11	0.13	0.38	7.80	0.42	8.74	0.89
	1412	2	0	0.17	0.11	0	0.11	0.14	0.35	7.28	0.44	9.10	0.80
	1526	2	0.01	0.15	0.11	0.01	0.07	0.16	0.33	6.76	0.40	8.37	0.81
Apr 26 90	819	2	0	0.12	0.12	0.01	0.09	0.12	0.30	6.24	0.37	7.64	0.82
	852	2	0	0.13	0.1	0.01	0.09	0.11	0.29	5.98	0.35	7.28	0.82
	921	2	0.01	0.13	0.13	0.01	0.1	0.12	0.33	6.76	0.39	8.01	0.84
	1038	2	0	0.16	0.09	0	0.07	0.09	0.31	6.50	0.28	5.82	1.12
	1124	2	0.01	0.13	0.09	0	0.07	0.11	0.28	5.72	0.32	6.55	0.87
	1307	2	0	0.12	0.11	0	0.07	0.07	0.29	5.98	0.25	5.10	1.17
	1404	2	0.01	0.14	0.11	0	0.08	0.12	0.31	6.50	0.35	7.28	0.89
	1433	2	0	0.14	0.13	0	0.09	0.09	0.34	7.02	0.31	6.55	1.07
	1532	2	0.01	0.15	0.1	0.01	0.08	0.1	0.31	6.50	0.32	6.55	0.99
Apr 27 90	718	2	0	0.2	0.12	0	0.13	0.11	0.40	8.32	0.42	8.74	0.95
	749	2	0.01	0.14	0.16	0.01	0.11	0.15	0.38	7.80	0.46	9.46	0.82
	823	2	0.01	0.17	0.14	0	-0.88	0.11	0.39	8.06	-1.35	-28.03	-0.29
	853	2	0.01	0.17	0.16	0.01	0.12	0.17	0.41	8.58	0.51	10.56	0.81
	928	2	0	0.17	0.17				0.43	8.84	0.00	0.00	ERR
	1029	2	0	0.14	0.15	0.01	0.1	0.14	0.36	7.54	0.42	8.74	0.86

Cont.

Table 2 - cont.

	1107	2	0.01	0.15	0.14	0	0.11	0.16	0.36	7.54	0.47	9.83	0.77
	1316	2	0	0.13	0.1	0.01	0.08	0.1	0.29	5.98	0.32	6.55	0.91
	1413	2	0	0.16	0.1	0.01	0.1	0.13	0.33	6.76	0.40	8.37	0.81
Apr 30 90	825	2	0.01	0.13	0.1	0.01	0.07	0.12	0.29	5.98	0.33	6.92	0.86
	858	2	0.01	0.14	0.11	0.01	0.05	0.11	0.31	6.50	0.28	5.82	1.12
	931	2	0.01	0.09	0.09	0.01	0.07	0.14	0.23	4.68	0.37	7.64	0.61
	1057	2	0	0.13	0.09	0.01	0.09	0.13	0.26	5.72	0.39	8.01	0.71
	1132	2	0	0.15	0.1	0.01	0.08	0.09	0.31	6.50	0.30	6.19	1.05
	1252	2	0	0.16	0.14	0	0.1	0.09	0.38	7.80	0.33	6.92	1.13
	1323	2	0.01	0.18	0.12	0	0.09	0.12	0.38	7.80	0.37	7.64	1.02
	1353	2	0	0.14	0.12	0.01	0.07	0.09	0.33	6.76	0.28	5.82	1.16
	1452	2	0.01	0.14	0.11	0	0.11	0.13	0.31	6.50	0.42	8.74	0.74
May 01 90	746	2	0	0.09	0.07	0	0.06	0.06	0.20	4.16	0.21	4.37	0.95
	823	2	0	0.09	0.03	0.01	0.04	0.04	0.15	3.12	0.14	2.91	1.07
	853	2	0.01	0.05	0.04	0.01	0.03	0.04	0.11	2.34	0.12	2.55	0.92
	924	2	0	0.09	0.02	0	0.05	0.01	0.14	2.86	0.11	2.18	1.31
	1111	2	0	0.11	0.02	0.01	0.14	0.03	0.16	3.36	0.30	6.19	0.55
	1256	2	0	0.12	0.07	0	0.07	0.06	0.24	4.94	0.23	4.73	1.04
	1407	2	0.01	0.12	0.07	0.01	0.06	0.06	0.24	4.94	0.21	4.37	1.13
	1534	2	0	0.14	0.04	0	0.05	0.06	0.23	4.66	0.19	4.00	1.17
May 02 90	806	2	0.01	0.1	0.04	0	0.07	0.04	0.18	3.64	0.19	4.00	0.91
	849	2	0	0.12	0.03		0.05	0.09	0.19	3.90	0.25	5.10	0.77
	926	2	0.01	0.11	0.1	0	0.06	0.09	0.26	5.46	0.26	5.46	1.00
	1047	2	0.01	0.1	0.06	0	0.07	0.07	0.20	4.16	0.18	3.64	1.14
	1123	2	0.01	0.11	0.07	0.01	0.06	0.06	0.23	4.68	0.21	4.37	1.07
	1302	2	0	0.15	0.11	0	0.06	0.08	0.33	6.76	0.25	5.10	1.33
	1332	2	0	0.12	0.05	0	0.09	0.06	0.21	4.42	0.26	5.46	0.81
	1407	2	0	0.11	0.09	0	0.09	0.09	0.25	5.20	0.31	6.55	0.79
May 03 90	806	2	0.01	0.12	0.08	0	0.09	0.11	0.25	5.20	0.35	7.28	0.71
	907	2	0.01	0.11	0.05	0	0.06	0.06	0.20	4.16	0.21	4.37	0.95
	936	2	0.01	0.13	0.08	0	0.07	0.07	0.26	5.46	0.25	5.10	1.07
	1035	2	0	0.12	0.1	0.01	0.06	0.08	0.28	5.72	0.25	5.10	1.12
	1137	2	0.01	0.11	0.06	0	0.06	0.08	0.21	4.42	0.25	5.10	0.87
	1313	2	0	0.15	0.07	0.01	0.07	0.06	0.28	5.72	0.23	4.73	1.21
	1344	2	0.01	0.12	0.07	0.01	0.08	0.05	0.24	4.94	0.23	4.73	1.04
	1419	2	0.01	0.13	0.1	0.01	0.05	0.06	0.29	5.98	0.19	4.00	1.49
May 04 90	811	2	0	0.14	0.09	0	0.08	0.08	0.29	5.98	0.28	5.82	1.03
	845	2	0	0.14	0.08	0	0.08	0.11	0.28	5.72	0.33	6.92	0.83
	917	2	0.01	0.14	0.11	0	0.08	0.1	0.31	6.50	0.32	6.55	0.99
	1030	2	0	0.15	0.13	0.01	0.08	0.09	0.35	7.28	0.30	6.19	1.18
	1100	2	0	0.14	0.08	0.01	0.08	0.12	0.28	5.72	0.35	7.28	0.79
	1336	2	0	0.15	0.11	0.02	0.09	0.11	0.33	6.76	0.35	7.28	0.93
	1421	2	0.01	0.16	0.13	0	0.09	0.13	0.36	7.54	0.39	8.01	0.94
May 07 90	826	2	0.01	0.06	0.03	0	0.04	0.05	0.11	2.34	0.16	3.28	0.71
	929	2	0.02	0.02	0.03	0	0.02	0.01	0.06	1.30	0.05	1.09	1.19
	1031	2	0.01	0	0.01		0	0.02	0.01	0.26	0.04	0.73	0.36
	1111	2	0	0.03	0	0	0.01	0.03	0.04	0.78	0.07	1.46	0.54
	1331	2	0	0.01	0	0.01	0	0.02	0.01	0.26	0.04	0.73	0.36
	1425	2	0.01	0	0.03		0	0	0.04	0.78	0.00	0.00	ERR
May 08 90	826	2	0.01	0	0.01	0.01	0	0.01	0.01	0.26	0.02	0.36	0.71
	1030	2	0.01	0.01	0.03		0	0.01	0.05	1.04	0.02	0.36	2.06
	1100	2	0.01	0.01	0.01	0.01	0	0.01	0.03	0.52	0.02	0.36	1.43
	1301	2	0.01	0.01	0.01	0	0.02	0.01	0.03	0.52	0.05	1.09	0.48
	1335	2	0.02	0.01	0.03	0.01	0.01	0.01	0.05	1.04	0.04	0.73	1.43
	1405	2	0	0.01	0	0	0.01	0.02	0.01	0.26	0.05	1.09	0.24
	1434	2	0.01	0.01	0.01	0.01	0	0	0.03	0.52	0.00	0.00	ERR

Cont.

Table 2 - cont.

May 09 90	806	2	0.01		0.01	0.01	0		0.01	0.02	0.03	0.52	0.05	1.09	0.48	
	840	2	0		0.03	0.03	0.01		0	0.02	0.08	1.56	0.04	0.73	2.14	
	922	2	0		0.01	0.03	0		0.02	0.01	0.05	1.04	0.05	1.09	0.95	
	1039	2	0		0.02	0.02	0		0.01	0.01	0.05	1.04	0.04	0.73	1.43	
	1123	2	0.01		0.01	0	0.01		0.01	0.01	0.01	0.26	0.04	0.73	0.36	
	1251	2	0.01		0	0.02	0		0.02	0	0.03	0.52	0.04	0.73	0.71	
	1321	2	0.01		0	0.01	0		-0.98	0.01	0.01	0.26	-1.70	-35.31	-0.01	
	1352	2	0.01		0.02	0.01	0		0.01	0.01	0.04	0.78	0.04	0.73	1.07	
May 10 90	926	2	0		0.19	0.11	0		0.12	0.13	0.38	7.80	0.44	9.10	0.86	
	1025	2	0		0.18	0.1	0.01		0.11	0.14	0.35	7.28	0.44	9.10	0.80	
	1055	2	0		0.21	0.11	0		0.13	0.11	0.40	8.32	0.42	8.74	0.95	
	1125	2	0		0.2	0.12	0.01		0.12	0.16	0.40	8.32	0.49	10.19	0.82	
	1306	2	0		0.14	0.11	0		0.08	0.07	0.31	6.50	0.26	5.46	1.19	
	1336	2	0		0.05	0.01	0.01		0.02	0.05	0.08	1.56	0.12	2.55	0.61	
	1407	2	0		0.03	0.02	0.01		0	0.02	0.06	1.30	0.04	0.73	1.79	
	1526	2	0		0.02	0.01	0.01		0.01	0	0.04	0.78	0.02	0.36	2.14	
May 11 90	833	2	0		0.02	0.01	0		0	0.01	0.04	0.78	0.02	0.36	2.14	
	903	2	0		0.01	0.03	0.01		0	0	0.05	1.04	0.00	0.00	ERR	
	934	2	0.01		0.01	0.01	0.01		0.01	0.03	0.03	0.52	0.07	1.46	0.36	
	1041	2	0		0.01	0.02	0.01		0.01	0.02	0.04	0.78	0.05	1.09	0.71	
	1112	2	0		0.01	0.01	0.01		0	0.00	0.03	0.52	0.00	0.00	ERR	
	1354	2	0.01		0.01	0.02	0.01		0.01	0.01	0.04	0.78	0.04	0.73	1.07	
	1424	2	0		0.01	0.03	0		0.01	0.03	0.05	1.04	0.07	1.46	0.71	
	Backgrounds outside RTTF															
May 14 90	93[illegible]	0	0.01		-0.01	-0.01	0		0.01	-0.03	-0.02	ERR	-0.02	ERR	ERR	
	904	0	0		0	-0.03	0		0.01	0.02	-0.03	-0.62	0.03	0.62	-1.00	
	930	0	0.01		-0.01	0.02	0		0	0.01	0.01	0.21	0.01	0.21	1.00	
	950	0	0.01		-0.01	0	0		0	-0.01	-0.01	-0.21	-0.01	-0.21	1.00	
	1025	0	0		0	0.01	0		0.01	0	0.01	0.21	0.01	0.21	1.00	
	1106	0	0		0	0.01	0.01		-0.01	-0.01	0.01	0.21	-0.02	-0.42	-0.50	
	1125	0	0.01		-0.01	0	0		0	0.02	-0.01	-0.21	0.02	0.42	-0.50	
	1150	0	0		0	0.01	0		0	0	0.01	0.21	0.00	0.00	ERR	
	1250	0	0		0	0.01	0		0	0	0.01	0.21	0.00	0.00	ERR	
	1315	0	0.01		0	-0.01	0		0	0.02	-0.01	-0.21	0.02	0.42	-0.50	
	Backgrounds inside RTTF										0.00	0.00	0.00	0.00	ERR	
	1345	0	0.01		-0.01	-0.01	0		0	-0.01	-0.02	-0.42	-0.01	-0.21	2.00	
	1413	0	0.01		-0.01	0	0.01		0.01	0	-0.01	-0.21	0.01	0.21	-1.00	
	1438	0	0.01		0	0.01	0.01		-0.01	0.01	0.01	0.21	0.00	0.00	ERR	
	1527	0	0.01		-0.01	0	0		0.01	0.05	-0.01	-0.21	0.06	1.25	-0.17	
May 15 90	747	0	0		0	-0.01	0.01		0	-0.01	-0.01	-0.21	-0.01	-0.21	1.00	
	823	0	0		0.01	-0.02	0.01		-0.01	0	-0.01	-0.21	-0.01	-0.21	1.00	
	848	0	0.01		-0.01	0	0.01		0	-0.01	-0.01	-0.21	-0.01	-0.21	1.00	
	915	0	0.01		0	-0.01	0.01		-0.01	0.01	-0.01	-0.21	0.00	0.00	ERR	
	941	0	0		0.01	0	0		0.01	0	0.01	0.21	0.01	0.21	1.00	
	1049	0	0.01		-0.01	-0.01	0		0.02	-0.02	-0.02	-0.42	0.00	0.00	ERR	
	1120	0	0		0.01	-0.02	0		0	-0.04	-0.01	-0.21	-0.04	-0.83	0.25	
	1145	0	0.01		0.01	0.01	0.01		0.01	0.01	0.02	0.42	0.02	0.42	1.00	
	Normal sampling															
May 16 90	747	2	0.01	-0.06	0.12	0.05	0.01	-0.06	0.06	0.06	0.21	4.42	0.21	4.37	1.01	bkrgd
	824	2	0	-29.8	0.1	3.48	0	-34.93	0.06	-0.84	4.48	93.08	-1.37	-28.39	-3.28	13.5
	911	2	0	-0.1	0.09	0.05	0.01	-0.08	0.04	0.03	0.18	3.64	0.12	2.55	1.43	bkrgd
	940	2	0.01	-5.81	0.07	-0.13	0	-5.98	0.07	-0.23	-0.08	-1.56	-0.28	-5.82	0.27	2.5
	1032	2	0	-6.06	0.11	-0.39	0	-5.9	0.05	-0.21	-0.35	-7.28	-0.28	-5.82	1.25	2.5
	1227	2	0	-0.05	0.09	0.09	0	-0.07	0.06	0.05	0.23	4.68	0.19	4.00	1.17	bkgrd
	1251	2	0.01	-5.79	0.09	-0.13	0.02	-5.88	0.03	-0.26	-0.05	-1.04	-0.40	-8.37	0.12	2.5
	1317	2	0	-0.07	0.11	0.06	0	-0.07	0.06	0.04	0.21	4.42	0.18	3.64	1.21	bkgrd

Cont.

Table 2 - cont.

	1351	2	0	-6.58	0.08	0.1	0	-6.74	0.04	-0.10	0.23	4.68	-0.11	-2.16	-2.14	2.5
	1422	2	0.01	-0.04	0.09	0.06	0	-0.04	0.05	0.04	0.19	3.90	0.16	3.28	1.19	bkgrd
	1533	2	0	-0.06	0.1	0.03	0.01	-0.05	0.04	0.04	0.16	3.38	0.14	2.91	1.16	bkgrd
May 17 90	737	2	-0.01	-0.04	0.07	0.05	0	-0.04	0.04	0.06	0.15	3.12	0.18	3.64	0.86	bkgrd
	804	2	0	-5.88	0.09	0.08	0	-6.03	0.05	-0.17	0.21	4.42	-0.21	-4.37	-1.01	2.5
	815	2	0	-5.86	0.09	-0.03	-0.01	-5.91	0.02	-0.16	0.08	1.56	-0.25	-5.10	-0.31	2.5
	827	2	-0.01	-2.95	0.08	0.06	-0.01	-2.95	0.05	-0.08	0.18	3.64	-0.05	-1.09	-3.33	1.5
	843	2	0	-3.08	0.08	-0.07	-0.01	-2.88	0.04	0.12	0.01	0.26	0.28	5.82	0.04	1.5
	904	2	0	-1.81	0.1	0.13	-0.01	-0.177	0.03	0.15	0.29	5.98	0.31	6.55	0.91	1
	913	2	-0.01	-1.86	0.07	0.04	0	-1.76	0.06	0.15	0.14	2.86	0.37	7.64	0.37	1
	922	2	0	-0.99	0.1	0.07	0	-0.97	0.05	0.07	0.21	4.42	0.21	4.37	1.01	0.5
	930	2	-0.01	-0.99	0.08	0.04	-0.01	-0.98	0.05	0.08	0.15	3.12	0.23	4.73	0.66	0.5
	941	2	-0.01	-0.05	0.1	0.02	0	-0.06	0.04	0.03	0.15	3.12	0.12	2.55	1.22	bkgrd
	950	2	0	-0.05	0.1	0.06	0	-0.05	0.04	0.04	0.20	4.16	0.14	2.91	1.43	bkgrd
	1039	2	-0.01	-0.11	0.06	0.01	0	-0.09	0.06	0.05	0.09	1.82	0.19	4.00	0.45	0.05
	1053	2	-0.01	-0.09	0.1	0.07	0	-0.1	0.06	0.05	0.21	4.42	0.19	4.00	1.10	0.05
	1101	2	0	-0.1	0.1	0.06	0	-0.1	0.06	0.04	0.20	4.16	0.18	3.64	1.14	0.05
	1117	2	0	-0.37	0.08	0.06	-0.01	-0.4	0.03	0.03	0.18	3.64	0.11	2.18	1.67	0.2
	1128	2	0	-0.36	0.11	0.07	0	-0.38	0.05	0.07	0.23	4.68	0.21	4.37	1.07	0.2
	1136	2	0	-0.4	0.09	-0.01	-0.01	-0.37	0.06	0.07	0.10	2.08	0.23	4.73	0.44	0.2
	1145	2	0	-0.98	0.11	0.07	0	-0.97	0.04	0.11	0.23	4.68	0.26	5.46	0.86	0.5
	1251	2	-0.01	-1.86	0.07	-0.01	-0.02	-1.95	0.04	-0.01	0.08	1.56	0.05	1.09	1.43	1
	1301	2	0	-3.05	0.1	0.09	0	-3.03	0.05	0.05	0.24	4.94	0.18	3.64	1.36	1.5
	1330	2	-0.01	-6.17	0.08	-0.08	-0.01	-6.03	0.04	0.10	0.00	0.00	0.25	5.10	0.00	2.5
	1349	2	0	-11.17	0.07	0.02	0	-11.01	0.06	-0.06	0.11	2.34	0.00	0.00	ERR	5
	1359	2	0	-10.99	0.1	0.19	0	-11.08	0.03	0.07	0.36	7.54	0.16	3.64	2.07	5
	1407	2	-0.01	-10.97	0.08	0.06	-0.01	-10.92	0.02	0.06	0.18	3.64	0.14	2.91	1.25	5
	1416	2	-0.01	-26.88	0.09	0.04	-0.01	-26.74	0.03	-0.07	0.16	3.38	-0.07	-1.46	-2.32	10
	1428	2	-0.01	-26.69	0.1	0.22	-0.01	-26.71	0.04	0.06	0.40	8.32	0.18	3.64	2.29	10
	1439	2	-0.01	-26.78	0.08	0.06	-0.01	-26.7	0.04	0.01	0.18	3.64	0.09	1.82	2.00	10
	1448	2	0	-0.07	0.11	0.02	0	-0.04	0.03	0.06	0.16	3.38	0.16	3.26	1.03	bkgrd
May 18 90	721	2	0.01	-0.06	0.05	0.03	0	-0.1	0.03	0	0.10	2.08	0.05	1.09	1.90	bkgrd
Sampling from inside the RTTF																
	758	2	0	-0.1	0.04	0	0	-0.1	0.03	0	0.05	1.04	0.05	1.09	0.95	bkgrd
	808	2	-0.01	-7.48	0.03	-0.03	0	-8.41	0.03	-0.11	0.00	0.00	-0.14	-2.91	0.00	3
	816	2	0	-7.46	0.08	0.39	-0.01	-7.43	0.01	0.16	0.59	12.22	0.30	6.19	1.97	3
	825	2	-0.01	-7.57	0.05	-0.06	-0.01	-7.59	0.04	-0.15	-0.01	-0.26	-0.19	-4.00	0.06	3
	836	2	0	-10.76	0.06	0.3	0	-11.05	0.04	-0.25	0.45	9.36	-0.37	-7.64	-1.22	5
	845	2	-0.01	-10.81	0.04	0.03	-0.01	-10.75	0.04	0.4	0.09	1.82	0.77	16.02	0.11	5
	854	2	-0.01	-10.96	0.07	-0.15	0	-11.05	0.03	-0.11	-0.10	-2.08	-0.14	-2.91	0.71	5
	906	2	0	-2.85	0.06	0.01	-0.01	-2.89	0.02	0.06	0.09	1.82	0.14	2.91	0.63	1.5
	914	2	-0.02	-2.87	0.05	0.03	-0.01	-2.94	0.03	-0.15	0.10	2.08	-0.21	-4.37	-0.48	1.5
	922	2	0	-2.99	0.07	-0.02	0	-2.91	0.04	-0.08	0.06	1.30	-0.07	-1.46	-0.89	1.5
	933	2	0	-0.08	0.07	0.05	-0.01	-0.07	0.02	0.05	0.15	3.12	0.12	2.55	1.22	bkgrd

Table 3 - Data by the Thomas-Tsivoglou method and according to the MDA-811.

	Thomas			MDA						
Date	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	Time	WL(1)	PAEC.(1) (uJ/m3)	WL(2)	PAEC.(2) (uJ/m3)	WL(1) / WL(Rn)	WL(2) / WL(Rn)
Mar 19 90	1120	0.041	0.85	1108	0.06	1.35	0.09	1.89	1.59	2.23
	1315	0.052	1.07	1307	0.06	1.35	0.07	1.42	1.26	1.32
Mar 20 90	813	0.056	1.18	807	0.03	0.68	0.18	3.78	0.57	3.22
	909	0.051	1.06	903	0.05	1.01	0.07	1.42	0.96	1.34
	1037	0.054	1.13	1033	0.06	1.35	0.11	2.36	1.19	2.09
	1125	0.046	0.96	1121	0.08	1.69	0.07	1.42	1.77	1.48
	1303	0.057	1.19	1258	0.03	0.68	0.09	1.89	0.57	1.58
	1347	0.050	1.05	1344	0.10	2.03	0.05	0.95	1.93	0.90
				1420	0.05	1.01	0.09	1.89		
Mar 21 90	819	0.052	1.08	815	0.06	1.35	0.07	1.42	1.25	1.31
	904	0.057	1.18	901	0.08	1.69	0.05	0.95	1.43	0.80
	1415	0.060	1.25	1410	0.10	2.03	0.05	0.95	1.62	0.76
	1528	0.067	1.38	1525	0.06	1.35	0.07	1.42	0.98	1.02
Mar 22 90	828	0.104	2.16	818	0.05	1.01	0.07	1.42	0.47	0.66
	902	0.104	2.17	858	0.06	1.35	0.07	1.42	0.62	0.65
	934	0.096	2.00	924	0.15	3.04	0.16	3.31	1.52	1.66
	1121	0.118	2.45	1040	0.13	2.70	0.16	3.31	1.10	1.35
	1257	0.114	2.38	1116	0.13	2.70	0.16	3.31	1.14	1.39
	1358	0.125	2.59	1254	0.15	3.04	0.11	2.36	1.17	0.91
	1433	0.124	2.59	1355	0.16	3.38	0.09	1.89	1.31	0.73
	1533	0.136	2.83	1425	0.13	2.70	0.16	3.31	0.95	1.17
				1530	0.08	1.69	0.05	0.95		
Mar 23 90	812	0.043	0.88	809	0.05	1.01	0.07	1.42	1.14	1.60
	849	0.040	0.83	846	0.10	2.03	0.05	0.95	2.43	1.13
	922	0.050	1.03	919	0.06	1.35	0.07	1.42	1.31	1.38
	1029	0.043	0.89	1026	0.05	1.01	0.09	1.89	1.14	2.13
	1232	0.061	1.27	1229	0.11	2.36	0.07	1.42	1.86	1.12
	1310	0.055	1.15	1307	0.08	1.69	0.07	1.42	1.47	1.23
	1344	0.070	1.45	1338	0.06	1.35	0.00	0.00	0.93	0.00
	1431	0.065	1.35	1428	0.11	2.36	0.02	0.47	1.75	0.35
Mar 26 90	816	0.055	1.15	813	0.08	1.69	0.07	1.42	1.47	1.23
	853	0.039	0.81	850	0.03	0.68	0.02	0.47	0.84	0.59
	928	0.037	0.76	925	0.11	2.36	0.05	0.95	3.09	1.24
	1033	0.039	0.81	1030	0.06	1.35	0.00	0.00	1.67	0.00
	1109	0.052	1.08	1106	0.03	0.68	0.07	1.42	0.62	1.31
	1301	0.052	1.09	1258	0.06	1.35	0.09	1.89	1.24	1.74
	1335	0.056	1.16	1332	0.06	1.35	0.05	0.95	1.16	0.81
	1416	0.055	1.14	1413	0.03	0.68	0.05	0.95	0.59	0.83
Apr 03 90	815	0.060	1.24	811	0.08	1.69	0.02	0.47	1.36	0.38
	902	0.102	2.11	859	0.06	1.35	0.05	0.95	0.64	0.45
	934	0.238	4.96	929	0.21	4.39	0.20	4.25	0.89	0.86
	1049	0.391	8.14	1046	0.45	9.45	0.41	8.51	1.16	1.05
	1125	0.415	8.63	1122	-1.20	-24.99	0.48	9.93	-2.90	1.15
	1349	0.451	9.38	1346	0.37	7.77	0.00	0.00	0.83	0.00
	1424	0.437	9.08	1421	0.49	10.13	0.48	9.93	1.12	1.09
Apr 04 90	824	0.494	10.28	821	0.54	11.14	0.52	10.87	1.08	1.06
	905	0.505	10.51	901	0.41	8.44	0.59	12.29	0.80	1.17
	1032	0.471	9.79	1029	0.34	7.09	0.48	9.93	0.72	1.01
	1109	0.466	9.68	1106	0.44	9.12	0.59	12.29	0.94	1.27
	1309	0.485	10.08	1306	0.44	9.12	0.61	12.76	0.90	1.27

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Table 3 - cont.

	1338	0.470	9.77	1334	0.54	11.14	0.57	11.82	1.14	1.21
	1419	0.478	9.93	1416	0.41	8.44	0.59	12.29	0.85	1.24
	1533	0.473	9.84	1530	0.41	8.44	0.59	12.29	0.86	1.25
Apr 05 90	815	0.517	10.76	812	0.50	10.47	0.64	13.24	0.97	1.23
	851	0.524	10.90	848	0.44	9.12	0.64	13.24	0.84	1.21
	929	0.504	10.48	926	0.45	9.45	0.73	15.13	0.90	1.44
	1035	0.492	10.23	1032	0.15	3.04	0.55	11.35	0.30	1.11
	1117	0.512	10.66	1114	0.54	11.14	0.57	11.82	1.05	1.11
	1301	0.499	10.39	1258	0.55	11.48	0.57	11.82	1.11	1.14
	1339	0.490	10.20	1333	0.52	10.81	0.50	10.40	1.06	1.02
	1421	0.498	10.36	1418	0.47	9.79	0.55	11.35	0.95	1.10
Apr 06 90	814	0.520	10.83	811	0.55	11.48	0.52	10.87	1.06	1.00
	849	0.509	10.59	846	0.58	12.16	0.55	11.35	1.15	1.07
	924	0.484	10.06	921	0.55	11.48	0.68	14.18	1.14	1.41
	1041	0.510	10.61	1038	0.45	9.45	0.57	11.82	0.89	1.11
	1115	0.502	10.45	1112	0.41	8.44	0.57	11.82	0.81	1.13
	1257	0.512	10.64	1254	0.54	11.14	0.50	10.40	1.05	0.98
	1340	0.515	10.72	1337	-1.14	-23.64	0.68	14.18	-2.21	1.32
	1415	0.482	10.02	1412	0.47	9.79	0.57	11.82	0.98	1.18
Apr 09 90	1129	0.662	13.78	1126	0.68	14.18	0.61	12.76	1.03	0.93
	1300	1.248	25.96	1257	1.27	26.34	1.43	29.78	1.01	1.15
	1335	1.306	27.16	1330	1.25	26.00	1.48	30.73	0.96	1.13
	1417	1.357	28.22	1414	1.20	24.99	1.39	28.84	0.89	1.02
Apr 10 90	923	1.261	26.23	920	1.19	24.65	1.50	31.20	0.94	1.19
	1030	1.269	26.40	1027	1.23	25.66	1.39	28.84	0.97	1.09
	1104	1.200	24.95	1101	1.15	23.97	1.34	27.89	0.96	1.12
	1256	1.304	27.12	1253	1.22	25.32	1.43	29.78	0.93	1.10
	1335	1.246	25.92	1332	1.15	23.97	1.32	27.42	0.92	1.06
	1426	1.230	25.58	1423	1.20	24.99	1.48	30.73	0.98	1.20
	1525	1.219	25.36	1536	1.25	26.00	1.55	32.15	1.03	1.27
	1710	1.259	26.19	1707	1.41	29.38	1.50	31.20	1.12	1.19
	1744	1.250	25.99	1741	1.30	27.01	1.50	31.20	1.04	1.20
	1819	1.252	26.03	1816	1.14	23.64	1.55	32.15	0.91	1.23
	1852	1.290	26.84	1849	1.15	23.97	1.27	26.47	0.89	0.99
	1928	1.251	26.03	1922	1.15	23.94	1.50	31.20	0.92	1.20
	2000	1.258	26.16	1957	1.20	25.04	1.54	31.97	0.96	1.22
Apr 11 90	814	1.277	26.55	811	1.29	26.82	1.57	32.57	1.01	1.23
	848	1.290	26.82	845	1.21	25.18	1.51	31.42	0.94	1.17
	928	1.267	26.35	925	1.25	26.00	1.57	32.57	0.99	1.24
	1035	1.375	28.61	1032	1.29	26.82	1.40	29.12	0.94	1.02
	1108	1.341	27.90	1105	1.36	28.19	1.60	33.33	1.01	1.19
	1259	1.328	27.62	1526	1.24	25.73	1.55	32.19	0.93	1.17
	1322	1.288	26.79	1329	1.28	26.55	1.53	31.80	0.99	1.19
	1404	1.340	27.88	1401	1.37	28.46	1.51	31.42	1.02	1.13
	1437	1.326	27.57	1434	1.36	28.19	1.51	31.42	1.02	1.14
Apr 12 90	810	1.376	28.63	807	1.45	30.11	1.62	33.72	1.05	1.18
	843	1.363	28.35	840	1.33	27.64	1.53	31.80	0.98	1.12
	922	1.376	28.62	919	1.38	28.74	1.64	34.10	1.00	1.19
	1041	1.362	28.33	1038	1.21	25.18	1.64	34.10	0.89	1.20
	1114	1.311	27.27	1111	1.38	28.74	1.57	32.57	1.05	1.19
Apr 18 90	754	0.153	3.19	751	0.19	3.90	0.16	3.28	1.22	1.03
	832	0.153	3.19	829	0.11	2.34	0.19	4.00	0.73	1.26
	907	0.151	3.14	904	0.21	4.42	0.18	3.64	1.41	1.16
	937	0.163	3.40	946	0.31	6.50	0.25	5.10	1.91	1.50
	1035	0.153	3.17	1032	0.20	4.16	0.18	3.64	1.31	1.15
	1107	0.153	3.19	1104	0.25	5.20	0.14	2.91	1.63	0.91

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Table 3 - cont.

	1137	0.136	2.84	1134	0.19	3.90	0.09	1.82	1.38	0.64
	1306	0.157	3.27	1303	0.18	3.64	0.14	2.91	1.11	0.89
	1343	0.143	2.98	1340	0.16	3.38	0.23	4.73	1.13	1.59
	1419	0.152	3.17	1416	0.19	3.90	0.14	2.91	1.23	0.92
Apr 19 90	817	0.211	4.39	814	0.26	5.46	0.14	2.91	1.24	0.66
	853	0.201	4.19	850	0.23	4.68	0.23	4.73	1.12	1.13
	926	0.217	4.52	923	-1.03	-21.32	0.18	3.64	-4.72	0.81
	1105	0.248	5.17	1102	0.23	4.68	0.30	6.19	0.91	1.20
	1135	0.310	6.46	1132	0.10	2.09	0.11	2.18	0.32	0.34
	1250	0.361	7.51	1240	0.38	7.80	0.44	9.10	1.04	1.21
	1323	0.324	6.74	1320	0.36	7.54	0.32	6.55	1.12	0.97
	1354	0.314	6.53	1351	0.33	6.76	0.30	6.19	1.04	0.95
	1432	0.308	6.41	1426	0.28	5.72	0.40	8.37	0.89	1.31
Apr 20 90	826	0.277	5.76	823	0.34	7.02	-1.38	-28.76	1.22	-4.99
	856	0.268	5.57	853	0.33	6.76	0.35	7.28	1.21	1.31
	930	0.270	5.61	927	0.26	5.46	0.35	7.28	0.97	1.30
	1034	0.270	5.62	1031	0.28	5.72	0.28	5.82	1.02	1.04
	1118	0.264	5.50	1115	0.29	5.98	0.40	8.37	1.09	1.52
	1259	0.288	6.00	1256	0.38	7.80	0.32	6.55	1.30	1.09
	1407	0.283	5.88	1404	0.24	4.94	0.30	6.19	0.84	1.05
	1536	0.367	7.64	1533	0.33	6.76	0.37	7.64	0.88	1.00
Apr 23 90	1309	0.210	4.36	1306	0.24	4.94	0.23	4.73	1.13	1.09
	1341	0.223	4.63	1338	0.24	4.94	0.28	5.82	1.07	1.26
	1415	0.222	4.62	1412	0.24	4.94	0.25	5.10	1.07	1.10
	1452	0.247	5.13	1449	0.25	5.20	0.37	7.64	1.01	1.49
Apr 24 90	823	0.316	6.58	818	0.33	6.76	0.37	7.64	1.03	1.16
	905	0.337	7.02	902	0.35	7.28	0.39	8.01	1.04	1.14
	1025	0.324	6.74	1022	0.36	7.54	0.37	7.64	1.12	1.13
	1058	0.334	6.95	1055	0.34	7.02	0.33	6.92	1.01	0.99
	1131	0.347	7.21	1128	0.36	7.54	0.42	8.74	1.05	1.21
	1306	0.373	7.77	1303	0.36	7.54	0.51	10.56	0.97	1.36
	1343	0.382	7.95	1340	0.41	8.58	0.44	9.10	1.08	1.14
	1422	0.394	8.20	1419	0.45	9.36	0.46	9.46	1.14	1.15
Apr 25 90	815	0.437	9.10	812	0.46	9.62	0.46	9.46	1.06	1.04
	849	0.419	8.71	846	0.45	9.36	0.47	9.83	1.07	1.13
	925	0.436	9.07	922	0.38	7.80	0.46	9.46	0.86	1.04
	1044	0.451	9.37	1041	0.41	8.58	0.46	9.46	0.92	1.01
	1126	0.426	8.85	1123	0.45	9.36	0.37	7.64	1.06	0.86
	1302	0.393	8.17	1259	0.35	7.28	0.40	8.37	0.89	1.02
	1339	0.395	8.23	1336	0.38	7.80	0.42	8.74	0.95	1.06
	1415	0.393	8.17	1412	0.35	7.28	0.44	9.10	0.89	1.11
	1529	0.357	7.43	1526	0.33	6.76	0.40	8.37	0.91	1.13
Apr 26 90	822	0.291	6.04	819	0.30	6.24	0.37	7.64	1.03	1.26
	855	0.294	6.12	852	0.29	5.98	0.35	7.28	0.98	1.19
	924	0.284	5.90	921	0.33	6.76	0.39	8.01	1.15	1.36
	1041	0.282	5.86	1038	0.31	6.50	0.28	5.82	1.11	0.99
	1127	0.275	5.72	1124	0.28	5.72	0.32	6.55	1.00	1.15
	1310	0.256	5.32	1307	0.29	5.98	0.25	5.10	1.12	0.96
	1407	0.308	6.41	1404	0.31	6.50	0.35	7.28	1.01	1.14
	1439	0.331	6.88	1433	0.34	7.02	0.31	6.55	1.02	0.95
	1535	0.311	6.48	1532	0.31	6.50	0.32	6.55	1.00	1.01
Apr 27 90	721	0.416	8.65	718	0.40	8.32	0.42	8.74	0.96	1.01
	752	0.398	8.27	749	0.38	7.80	0.46	9.46	0.94	1.14
	826	0.406	8.45	823	0.39	8.06	-1.35	-28.03	0.95	-3.32
	856	0.436	9.08	853	0.41	8.58	0.51	10.56	0.95	1.16
	931	0.567	11.79	928	0.43	8.84	0.00	0.00	0.75	0.00

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Table 3 - cont.

	1032	0.401	8.33	1029	0.36	7.54	0.42	8.74	0.90	1.05
	1110	0.363	7.54	1107	0.36	7.54	0.47	9.83	1.00	1.30
	1319	0.320	6.65	1316	0.29	5.98	0.32	6.55	0.90	0.99
	1416	0.315	6.55	1413	0.33	6.76	0.40	8.37	1.03	1.28
Apr 30 90	828	0.304	6.32	825	0.29	5.98	0.33	6.92	0.95	1.09
	901	0.309	6.42	858	0.31	6.50	0.28	5.82	1.01	0.91
	934	0.322	6.70	931	0.23	4.68	0.37	7.64	0.70	1.14
	1101	0.351	7.30	1057	0.28	5.72	0.39	8.01	0.78	1.10
	1135	0.328	6.83	1132	0.31	6.50	0.30	6.19	0.95	0.91
	1255	0.314	6.53	1252	0.38	7.80	0.33	6.92	1.19	1.06
	1326	0.313	6.51	1323	0.38	7.80	0.37	7.64	1.20	1.17
	1356	0.302	6.28	1353	0.33	6.76	0.28	5.82	1.08	0.93
	1428	0.373	7.75	1452	0.31	6.50	0.42	8.74	0.84	1.13
May 01 90	749	0.122	2.54	746	0.20	4.16	0.21	4.37	1.64	1.72
	826	0.139	2.89	823	0.15	3.12	0.14	2.91	1.08	1.01
	856	0.136	2.82	853	0.11	2.34	0.12	2.55	0.83	0.90
	928	0.132	2.75	924	0.14	2.86	0.11	2.18	1.04	0.79
	1114	0.162	3.37	1111	0.16	3.38	0.30	6.19	1.00	1.84
	1259	0.212	4.40	1256	0.24	4.94	0.23	4.73	1.12	1.08
	1410	0.199	4.14	1407	0.24	4.94	0.21	4.37	1.19	1.05
	1537	0.194	4.03	1534	0.23	4.68	0.19	4.00	1.16	0.99
May 02 90	811	0.182	3.79	806	0.18	3.64	0.19	4.00	0.96	1.06
	852	0.193	4.01	849	0.19	3.90	0.25	5.10	0.97	1.27
	929	0.209	4.35	926	0.26	5.46	0.26	5.46	1.26	1.26
	1050	0.282	5.87	1047	0.20	4.16	0.18	3.64	0.71	0.62
	1126	0.239	4.96	1123	0.23	4.68	0.21	4.37	0.94	0.88
	1305	0.259	5.38	1302	0.33	6.76	0.25	5.10	1.26	0.95
	1335	0.253	5.26	1332	0.21	4.42	0.26	5.46	0.84	1.04
	1410	0.263	5.46	1407	0.25	5.20	0.31	6.55	0.95	1.20
May 03 90	809	0.242	5.03	806	0.25	5.20	0.35	7.28	1.03	1.45
	910	0.213	4.44	907	0.20	4.16	0.21	4.37	0.94	0.98
	939	0.228	4.74	936	0.26	5.46	0.25	5.10	1.15	1.08
	1038	0.259	5.38	1035	0.28	5.72	0.25	5.10	1.06	0.95
	1109	0.227	4.71	1137	0.21	4.42	0.25	5.10	0.94	1.08
	1140	0.207	4.30	1313	0.28	5.72	0.23	4.73	1.33	1.10
	1316	0.221	4.59	1344	0.24	4.94	0.23	4.73	1.08	1.03
	1347	0.241	5.02	1419	0.29	5.98	0.19	4.00	1.19	0.80
	1422	0.233	4.85							
May 04 90	815	0.251	5.22	811	0.29	5.98	0.28	5.82	1.15	1.12
	849	0.290	6.04	845	0.28	5.72	0.33	6.92	0.95	1.15
	920	0.287	5.98	917	0.31	6.50	0.32	6.55	1.09	1.10
	1033	0.280	5.82	1030	0.35	7.28	0.30	6.19	1.25	1.06
	1103	0.290	6.03	1100	0.28	5.72	0.35	7.28	0.95	1.21
	1339	0.322	6.69	1336	0.33	6.76	0.35	7.28	1.01	1.09
	1424	0.317	6.60	1421	0.36	7.54	0.39	8.01	1.14	1.21
May 07 90	829	0.169	3.51	826	0.11	2.34	0.16	3.28	0.67	0.93
	932	0.038	0.80	929	0.06	1.30	0.05	1.09	1.63	1.37
	1034	0.016	0.34	1031	0.01	0.26	0.04	0.73	0.76	2.12
	1117	0.023	0.47	1111	0.04	0.78	0.07	1.46	1.66	3.11
	1337	0.022	0.46	1331	0.01	0.26	0.04	0.73	0.56	1.57
	1428	0.022	0.46	1425	0.04	0.78	0.00	0.00	1.70	0.00
May 08 90	829	0.019	0.40	826	0.01	0.26	0.02	0.36	0.66	0.92
	1033	0.048	1.00	1030	0.05	1.04	0.02	0.36	1.04	0.36
	1103	0.024	0.51	1100	0.03	0.52	0.02	0.36	1.02	0.72
	1304	0.040	0.84	1301	0.03	0.52	0.05	1.09	0.62	1.30
	1338	0.026	0.54	1335	0.05	1.04	0.04	0.73	1.92	1.34

Cont.

Table 3 - cont.

	1408	0.026	0.54	1405	0.01	0.26	0.05	1.09	0.48	2.03
	1441	0.033	0.68	1434	0.03	0.52	0.00	0.00	0.77	0.00
May 09 90	809	0.028	0.57	806	0.03	0.52	0.05	1.09	0.91	1.91
	848	0.018	0.37	840	0.08	1.56	0.04	0.73	4.24	1.98
	925	0.019	0.40	922	0.05	1.04	0.05	1.09	2.63	2.76
	1042	0.034	0.70	1039	0.05	1.04	0.04	0.73	1.48	1.04
	1126	0.020	0.41	1123	0.01	0.26	0.04	0.73	0.64	1.76
	1254	0.022	0.46	1251	0.03	0.52	0.04	0.73	1.12	1.57
	1324	0.021	0.43	1321	0.01	0.26	-1.70	-35.31	0.61	-82.50
	1355	0.026	0.53	1352	0.04	0.78	0.04	0.73	1.46	1.36
	1426	0.021	0.43					0.00	0.00	0.00
May 10 90	929	0.364	7.58	926	0.38	7.80	0.44	9.10	1.03	1.20
	1028	0.394	8.20	1025	0.35	7.28	0.44	9.10	0.89	1.11
	1058	0.389	8.09	1055	0.40	8.32	0.42	8.74	1.03	1.08
	1128	0.414	8.60	1125	0.40	8.32	0.49	10.19	0.97	1.18
	1309	0.242	5.03	1306	0.31	6.50	0.26	5.46	1.29	1.09
	1339	0.073	1.52	1336	0.08	1.56	0.12	2.55	1.03	1.68
	1410	0.041	0.85	1407	0.06	1.30	0.04	0.73	1.54	0.86
	1529	0.033	0.70	1526	0.04	0.78	0.02	0.36	1.12	0.52
May 11 90	836	0.018	0.38	833	0.04	0.78	0.02	0.36	2.05	0.96
	906	0.020	0.42	903	0.05	1.04	0.00	0.00	2.51	0.00
	936	0.021	0.43	934	0.03	0.52	0.07	1.46	1.20	3.35
	1044	0.017	0.36	1041	0.04	0.78	0.05	1.09	2.17	3.04
	1115	0.016	0.32	1112	0.03	0.52	0.00	0.00	1.61	0.00
	1357	0.046	0.95	1354	0.04	0.76	0.04	0.73	0.82	0.77
	1427	0.028	0.57	1424	0.05	1.04	0.07	1.46	1.81	2.53
May 16 90	750	0.217	4.51	747	0.21	4.42	0.21	4.37	0.98	0.97
	827	0.199	4.15	824	4.48	93.08	-1.37	-28.39	22.43	-6.84
	914	0.173	3.60	911	0.18	3.64	0.12	2.55	1.01	0.71
	1019	0.174	3.63	940	-0.08	-1.56	-0.28	-5.82	-0.43	-1.61
	1230	0.173	3.59	1032	-0.35	-7.28	-0.28	-5.82	-2.03	-1.62
	1304	0.147	3.06	1227	0.23	4.68	0.19	4.00	1.53	1.31
	1354	0.161	3.35	1251	-0.05	-1.04	-0.40	-8.37	-0.31	-2.50
	1425	0.145	3.02	1317	0.21	4.42	0.16	3.64	1.46	1.20
				1351	0.23	4.68	-0.11	-2.18		
				1422	0.19	3.90	0.16	3.28		
				1533	0.16	3.38	0.14	2.91		
May 17 90	743	0.151	3.15	737	0.15	3.12	0.18	3.64	0.99	1.16
	846	0.181	3.76	804	0.21	4.42	-0.21	-4.37	1.18	-1.16
	1042	0.155	3.22	815	0.08	1.56	-0.25	-5.10	0.48	-1.58
	1122	0.171	3.55	827	0.18	3.64	-0.05	-1.09	1.02	-0.31
	1304	0.158	3.29	843	0.01	0.26	0.28	5.82	0.08	1.77
	1419	0.158	3.29	904	0.29	5.98	0.31	6.55	1.82	1.99
				913	0.14	2.86	0.37	7.64		
				922	0.21	4.42	0.21	4.37		
				930	0.15	3.12	0.23	4.73		
				941	0.15	3.12	0.12	2.55		
				950	0.20	4.16	0.14	2.91		
				1039	0.09	1.82	0.19	4.00		
				1053	0.21	4.42	0.19	4.00		
				1101	0.20	4.16	0.18	3.64		
				1117	0.18	3.64	0.11	2.18		
				1128	0.23	4.68	0.21	4.37		
				1136	0.10	2.08	0.23	4.73		
				1145	0.23	4.68	0.26	5.46		

Cont.

Table 3 - cont.

				1251	0.08	1.56	0.05	1.09		
				1301	0.24	4.94	0.18	3.64		
				1330	0.00	0.00	0.25	5.10		
				1349	0.11	2.34	0.00	0.00		
				1359	0.36	7.54	0.18	3.64		
				1407	0.18	3.64	0.14	2.91		
				1416	0.16	3.38	-0.07	-1.46		
				1428	0.40	8.32	0.18	3.64		
				1439	0.18	3.64	0.09	1.82		
				1448	0.16	3.38	0.16	3.28		
May 18 90	724	0.096	1.99	721	0.10	2.08	0.05	1.09	1.05	0.55
				Sampling from inside the RTTF						
				758	0.05	1.04	0.05	1.09		
				808	0.00	0.00	-0.14	-2.91		
				816	0.59	12.22	0.30	6.19		
				825	-0.01	-0.26	-0.19	-4.00		
				836	0.45	9.36	-0.37	-7.64		
				845	0.09	1.82	0.77	16.02		
				854	-0.10	-2.08	-0.14	-2.91		
				906	0.09	1.82	0.14	2.91		
				914	0.10	2.08	-0.21	-4.37		
				922	0.06	1.30	-0.07	-1.46		
	1026	0.075	1.55	933	0.15	3.12	0.12	2.55	2.01	1.64

Table 4 - Data by the Thomas-Tsivoglou method. Also shown are other environmental data.

		Grab samples (Thomas)																
												Radon gas conc. RGM-2						
Date	Time	[218Po]		[214Pb]		[214Bi]		WL(Rn)	PAEC(Rn)	[214Pb]	[214Bi]					Temp	RH	N
		pCi/L	Bq/m3	pCi/L	Bq/m3	pCi/L	Bq/m3		(uJ/m3)	[218Po]	[218Po]	pCi/L	stdv	Bq/m3	stdv	oC	%	(cm-3)
Mar 19 90	1120	22.93	848.49	2.53	93.48	1.16	42.95	0.041	0.85	0.110	0.051	84.69	7.10	3133.46	262.77	21	40	100-400
	1315	28.61	1058.63	3.84	142.18	0.69	25.55	0.052	1.07	0.134	0.024							
Mar 20 90	813	31.22	1155.03	4.42	163.62	0.51	19.02	0.056	1.18	0.142	0.016	89.94	1.30	3327.81	48.09	21	38	100-300
	909	24.47	905.37	3.37	124.65	2.30	85.08	0.051	1.06	0.138	0.094							
	1037	22.66	838.35	4.30	159.28	2.49	92.23	0.054	1.13	0.190	0.110							
	1125	20.24	748.97	2.37	87.80	3.51	129.92	0.046	0.96	0.117	0.173							
	1303	28.40	1050.83	4.65	171.87	1.24	45.86	0.057	1.19	0.164	0.044							
	1347	21.05	778.67	3.62	133.80	2.80	103.68	0.050	1.05	0.172	0.133							
Mar 21 90	819	23.18	857.69	3.18	117.79	3.25	120.23	0.052	1.08	0.137	0.140	90.80	2.12	3359.54	78.34	21	51	100-390
	904	26.98	998.21	4.72	174.48	1.32	48.82	0.057	1.18	0.175	0.049							
	1415	25.37	938.74	3.90	144.20	3.81	140.94	0.060	1.25	0.154	0.150							
	1526	25.04	926.65	5.12	189.60	3.96	146.44	0.067	1.38	0.205	0.158							
Mar 22 90	828	35.36	1308.30	10.68	395.13	3.54	130.97	0.104	2.16	0.302	0.100	91.99	1.06	3403.67	39.17	21	57	120-280
	902	34.88	1290.67	11.02	407.68	3.34	123.51	0.104	2.17	0.316	0.096							
	934	26.18	968.55	8.41	311.28	7.06	261.17	0.096	2.00	0.321	0.270							
	1121	39.27	1453.11	10.97	406.06	5.77	213.34	0.118	2.45	0.279	0.147							
	1257	30.46	1126.85	9.47	350.27	9.34	345.76	0.114	2.38	0.311	0.307							
	1358	32.26	1193.66	11.17	413.30	9.32	344.71	0.125	2.59	0.346	0.289							
	1433	32.75	1211.84	12.83	474.78	6.82	252.43	0.124	2.59	0.392	0.208							
	1533	39.53	1462.43	13.16	486.76	7.69	284.49	0.136	2.83	0.333	0.195							
Mar 23 90	812	18.59	687.75	2.00	73.99	3.55	131.44	0.043	0.88	0.108	0.191	91.59	1.18	3388.79	43.63	21	49	90-350
	849	16.82	622.45	1.43	52.78	4.16	153.91	0.040	0.83	0.085	0.247							
	922	25.08	927.91	4.09	151.29	0.80	29.62	0.050	1.03	0.163	0.032							
	1029	15.81	585.02	2.49	91.99	3.67	135.75	0.043	0.89	0.157	0.232							
	1232	25.13	929.83	4.84	179.00	2.83	104.74	0.061	1.27	0.193	0.113							
	1310	19.97	738.81	3.98	147.20	3.91	144.70	0.055	1.15	0.199	0.196							
	1344	27.36	1012.15	6.78	250.96	1.96	72.42	0.070	1.45	0.248	0.072							
	1431	26.67	986.93	4.52	167.37	3.92	144.98	0.065	1.35	0.170	0.147							
Mar 26 90	816	29.87	1105.25	3.32	122.87	2.08	77.10	0.055	1.15	0.111	0.070	91.23	1.57	3375.41	58.01	21	46	180-450
	853	20.18	746.61	1.92	70.94	2.20	81.54	0.039	0.81	0.095	0.109							
	928	17.15	634.57	2.08	76.81	2.29	84.73	0.037	0.76	0.121	0.134							
	1033	22.47	831.52	2.37	87.67	1.01	37.19	0.039	0.81	0.105	0.045							
	1109	25.63	948.45	2.83	104.54	3.03	112.13	0.052	1.08	0.110	0.118							
	1301	28.52	1055.06	3.01	111.52	2.03	75.21	0.052	1.09	0.106	0.071							
	1335	28.99	1072.64	3.96	146.37	1.58	58.60	0.056	1.16	0.136	0.055							
	1416	29.77	1101.53	3.71	137.36	1.39	51.38	0.055	1.14	0.125	0.047							
Apr 03 90	815	30.70	1136.04	3.78	139.78	2.42	89.58	0.060	1.24	0.123	0.079	92.82	1.55	3434.41	57.51	21	49	300-24000
	902	49.45	1829.76	9.26	342.57	0.97	35.92	0.102	2.11	0.187	0.020							
	934	55.37	2048.55	25.45	941.60	13.99	517.65	0.238	4.96	0.460	0.253							
	1049	49.27	1823.10	40.47	1497.30	36.16	1337.97	0.391	8.14	0.821	0.734							
	1125	58.92	2180.05	41.70	1542.81	38.14	1411.24	0.415	8.63	0.708	0.647							
	1349	68.53	2535.56	48.62	1799.06	35.82	1325.33	0.451	9.38	0.710	0.523							
	1424	60.27	2230.10	44.78	1656.68	39.43	1459.01	0.437	9.08	0.743	0.654							
Apr 04 90	824	83.14	3076.33	52.31	1935.50	38.36	1419.27	0.494	10.28	0.629	0.461	96.39	1.90	3566.29	70.40	21	48	2.6E+04
	905	87.67	3243.78	56.62	2095.00	34.23	1266.59	0.505	10.51	0.646	0.390							
	1032	58.93	2180.36	48.24	1785.01	44.25	1637.37	0.471	9.79	0.819	0.751							
	1109	56.03	2073.06	48.62	1798.89	43.17	1597.32	0.466	9.68	0.868	0.771							
	1309	77.36	2862.27	51.29	1897.91	38.72	1432.68	0.485	10.08	0.663	0.501							
	1338	69.01	2553.43	48.27	1785.91	41.14	1522.18	0.470	9.77	0.699	0.596							
	1419	71.80	2656.71	49.67	1837.75	40.59	1501.75	0.478	9.93	0.692	0.565							

Cont.

Table 4 - cont.

	1533	70.32	2601.76	48.97	1811.99	40.77	1508.61	0.473	9.84	0.696	0.580							
Apr 05 90	815	76.25	2821.42	54.95	2033.22	42.80	1583.51	0.517	10.76	0.721	0.561	100.50	2.02	3718.50	74.87	21	46	2.7E+04
	851	78.74	2913.39	58.53	2165.67	39.14	1448.17	0.524	10.90	0.743	0.497							
	929	77.34	2861.45	52.57	1945.06	42.17	1560.41	0.504	10.48	0.680	0.545							
	1035	57.32	2120.83	50.26	1859.70	47.62	1761.88	0.492	10.23	0.877	0.831							
	1117	64.09	2371.37	56.84	2102.92	42.30	1565.13	0.512	10.66	0.887	0.660							
	1301	73.09	2704.31	51.71	1913.44	43.31	1602.40	0.499	10.39	0.708	0.593							
	1339	61.43	2272.98	49.58	1834.29	47.00	1738.82	0.490	10.20	0.807	0.765							
	1421	72.41	2679.17	51.83	1917.63	42.96	1589.40	0.498	10.36	0.716	0.593							
Apr 06 90	814	81.23	3005.66	56.52	2091.21	40.18	1486.51	0.520	10.83	0.696	0.495	98.69	1.45	3651.57	53.55	21	51	2.9E+04
	849	70.12	2594.50	54.13	2002.69	43.46	1607.90	0.509	10.59	0.772	0.620							
	924	59.44	2199.19	48.13	1780.91	47.71	1765.18	0.484	10.06	0.810	0.803							
	1041	75.15	2780.52	53.87	1993.04	42.69	1579.55	0.510	10.61	0.717	0.568							
	1115	73.58	2722.58	50.42	1865.67	45.67	1689.91	0.502	10.45	0.605	0.621							
	1257	76.58	2833.29	54.22	2006.32	42.25	1563.17	0.512	10.64	0.708	0.552							
	1340	88.37	3269.87	54.53	2017.75	39.49	1461.31	0.515	10.72	0.617	0.447							
	1415	51.39	1901.52	45.69	1690.70	52.75	1951.73	0.482	10.02	0.889	1.026							
Apr 09 90	1129	164.06	6070.16	71.06	2629.23	35.60	1317.32	0.662	13.78	0.433	0.217	182.41	72.20	6749.33	2671.37	21	54	60-28000
	1300	182.82	6764.30	132.77	4912.38	103.41	3826.24	1.248	25.96	0.726	0.566							
	1335	193.13	7145.93	137.18	5075.70	110.03	4070.93	1.306	27.16	0.710	0.570							
	1417	196.45	7268.81	144.91	5361.83	112.19	4150.98	1.357	28.22	0.738	0.571							
Apr 10 90	923	203.12	7515.57	134.64	4981.54	98.77	3654.39	1.261	26.23	0.663	0.486	235.89	2.21	8728.06	81.81	21	54	2.9E+04
	1030	192.67	7128.75	134.04	4959.54	104.64	3871.60	1.269	26.40	0.696	0.543							
	1104	169.31	6264.58	124.73	4615.19	105.05	3886.80	1.200	24.95	0.737	0.620							
	1256	224.74	8315.21	143.07	5293.51	92.80	3433.57	1.304	27.12	0.637	0.413							
	1335	174.42	6453.38	132.37	4897.78	105.72	3911.58	1.246	25.92	0.759	0.606							
	1426	158.79	5875.15	128.79	4765.35	110.60	4092.03	1.230	25.58	0.811	0.696							
	1525	166.53	6161.73	122.02	4514.81	114.82	4248.32	1.219	25.36	0.733	0.689							
	1710	190.26	7039.47	131.69	4872.63	105.77	3913.55	1.259	26.19	0.692	0.556							
	1744	178.78	6614.74	131.79	4876.38	106.22	3930.28	1.250	25.99	0.737	0.594							
	1819	159.38	5896.89	129.96	4808.37	114.64	4241.62	1.252	26.03	0.815	0.719							
	1852	200.82	7430.37	137.72	5095.70	103.01	3811.36	1.290	26.84	0.686	0.513							
	1928	186.02	6882.72	135.30	5005.92	99.94	3697.90	1.251	26.03	0.727	0.537							
	2000	183.47	6788.54	131.66	4871.44	107.30	3969.99	1.258	26.16	0.718	0.585							
Apr 11 90	814	171.58	6348.40	136.76	5060.18	108.71	4022.32	1.277	26.55	0.797	0.634	249.47	5.44	9230.31	201.29	21	46	2.9E+04
	848	202.79	7503.22	133.05	4922.92	108.62	4019.06	1.290	26.82	0.656	0.536							
	928	175.83	6505.64	127.02	4699.69	118.14	4371.09	1.267	26.35	0.722	0.672							
	1035	243.84	9022.15	153.71	5687.42	92.17	3410.14	1.375	28.61	0.630	0.378							
	1108	205.63	7608.37	144.32	5339.85	106.35	3934.85	1.341	27.90	0.702	0.517							
	1259	177.81	6579.14	140.07	5182.55	116.29	4302.83	1.328	27.62	0.788	0.654							
	1322	157.82	5839.49	132.36	4897.27	121.56	4497.88	1.288	26.79	0.839	0.770							
	1404	198.44	7342.36	142.41	5269.14	110.73	4097.15	1.340	27.88	0.718	0.558							
	1437	199.63	7386.16	143.56	5311.54	104.85	3879.38	1.326	27.57	0.719	0.525							
Apr 12 90	810	206.09	7625.43	147.06	5441.18	111.93	4141.38	1.376	28.63	0.714	0.543	163.55	104.99	6051.24	3884.59	21	53	21000-28000
	843	188.00	6958.80	147.36	5452.24	112.88	4176.67	1.363	28.35	0.784	0.600							
	922	207.76	7687.04	143.93	5325.29	115.60	4277.08	1.376	28.62	0.693	0.556							
	1041	200.31	7411.58	144.78	5356.81	112.75	4171.70	1.362	28.33	0.723	0.563							
	1114	156.29	5782.71	133.03	4922.16	127.29	4709.80	1.311	27.27	0.851	0.814							
Apr 18 90	754	71.65	2651.15	12.84	474.92	3.86	142.94	0.153	3.19	0.179	0.054	214.27	6.16	7927.84	228.07	10.7	63	80-240
	832	73.14	2706.21	11.09	410.32	5.79	214.38	0.153	3.19	0.152	0.079							
	907	55.75	2062.75	11.92	441.06	8.81	326.12	0.151	3.14	0.214	0.158							
	937	72.98	2700.38	13.74	508.39	4.94	182.64	0.163	3.40	0.188	0.068							
	1035	72.76	2692.11	9.67	357.85	7.67	283.83	0.153	3.17	0.133	0.105							
	1107	67.25	2488.31	9.09	336.25	10.18	376.75	0.153	3.19	0.135	0.151							
	1137	46.42	1717.49	9.14	338.03	11.30	418.03	0.136	2.84	0.197	0.243							
	1306	64.56	2388.54	11.98	443.19	8.03	297.15	0.157	3.27	0.186	0.124							

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Table 4 - cont.

	1343	59.75	2210.60	10.27	379.98	7.92	293.21	0.143	2.98	0.172	0.133							
	1419	62.69	2319.62	12.61	466.54	6.39	236.43	0.152	3.17	0.201	0.102							
Apr 19 90	817	72.65	2688.16	19.03	704.18	10.59	391.70	0.211	4.39	0.262	0.146	211.18	2.14	7813.81	79.33	10.6	61	40-300
	853	64.52	2387.23	17.64	652.81	12.19	451.09	0.201	4.19	0.273	0.189							
	926	72.60	2686.23	21.06	780.06	9.50	351.49	0.217	4.52	0.290	0.131							
	1105	80.58	2981.31	20.47	757.23	16.48	609.94	0.248	5.17	0.254	0.205							
	1135	92.94	3438.90	28.54	1055.81	18.74	693.30	0.310	6.46	0.307	0.202							
	1250	103.75	3838.89	33.01	1221.20	23.29	861.86	0.361	7.51	0.318	0.225							
	1323	81.45	3013.73	29.96	1108.70	23.56	871.67	0.324	6.74	0.368	0.289							
	1354	82.93	3068.36	29.67	1097.64	20.86	771.99	0.314	6.53	0.358	0.252							
	1432	89.16	3298.75	31.33	1159.32	15.31	566.45	0.308	6.41	0.351	0.172							
Apr 20 90	826	78.72	2912.68	27.79	1028.25	14.74	545.49	0.277	5.76	0.353	0.187	223.91	19.83	8284.82	733.78	10.7	57	150-240
	856	82.24	3042.81	24.07	890.71	16.33	604.21	0.268	5.57	0.293	0.199							
	930	74.47	2755.43	26.00	962.17	16.32	603.96	0.270	5.61	0.349	0.219							
	1034	72.22	2672.09	27.42	1014.64	15.24	563.79	0.270	5.62	0.380	0.211							
	1118	68.79	2545.31	24.22	896.26	18.88	698.71	0.264	5.50	0.352	0.275							
	1259	86.45	3198.75	27.22	1007.01	16.39	606.49	0.288	6.00	0.315	0.190							
	1407	76.54	2831.94	23.46	867.99	22.70	839.95	0.283	5.88	0.307	0.297							
	1536	94.56	3498.75	36.86	1363.68	22.23	822.52	0.367	7.64	0.390	0.235							
Apr 23 90	1309	74.66	2762.32	16.09	595.48	13.68	506.32	0.210	4.36	0.216	0.183	227.53	4.29	8418.68	158.66	22-26	55	90-200
	1341	68.37	2529.59	20.19	747.19	13.36	494.39	0.223	4.63	0.295	0.195							
	1415	57.23	2117.40	18.15	671.57	19.07	705.56	0.222	4.62	0.317	0.333							
	1452	72.65	2687.94	21.97	812.97	16.15	597.40	0.247	5.13	0.302	0.222							
Apr 24 90	823	77.25	2858.11	29.91	1106.49	22.81	843.89	0.316	6.58	0.387	0.295	228.87	3.48	8468.26	128.91	26	48	100-500
	905	89.45	3309.72	33.75	1248.92	19.83	733.85	0.337	7.02	0.377	0.222							
	1025	80.55	2980.51	29.23	1081.56	24.91	921.69	0.324	6.74	0.363	0.309							
	1058	90.81	3360.13	30.70	1136.01	22.75	841.92	0.334	6.95	0.338	0.251							
	1131	86.48	3199.91	32.20	1191.32	25.26	934.67	0.347	7.21	0.372	0.292							
	1306	84.28	3118.28	34.27	1268.09	30.18	1116.60	0.373	7.77	0.407	0.358							
	1343	101.12	3741.53	33.91	1254.81	28.45	1052.62	0.382	7.95	0.335	0.281							
	1422	86.06	3184.25	37.26	1378.58	31.18	1153.68	0.394	8.20	0.433	0.362							
Apr 25 90	815	105.29	3895.76	42.03	1555.21	30.98	1146.36	0.437	9.10	0.399	0.294	230.21	3.75	8517.84	138.82	26	52	150-400
	849	99.89	3695.85	37.37	1382.51	33.82	1251.48	0.419	8.71	0.374	0.339							
	925	105.62	3907.88	43.01	1591.40	29.22	1081.09	0.436	9.07	0.407	0.277							
	1044	98.28	3636.53	48.08	1778.95	28.26	1045.46	0.451	9.37	0.489	0.287							
	1126	95.25	3524.34	41.97	1552.80	30.68	1135.17	0.426	8.85	0.441	0.322							
	1302	93.18	3447.66	36.12	1336.37	30.45	1126.48	0.393	8.17	0.388	0.327							
	1339	101.68	3762.21	39.12	1447.41	24.71	914.39	0.395	8.23	0.385	0.243							
	1415	108.66	4020.43	39.84	1474.10	21.10	780.56	0.393	8.17	0.367	0.194							
	1529	94.09	3481.45	34.33	1270.16	23.07	853.52	0.357	7.43	0.365	0.245							
Apr 26 90	822	85.99	3181.78	26.76	990.18	17.74	656.50	0.291	6.04	0.311	0.206	228.34	3.08	8448.43	114.03	21-26	32-86	150-210
	855	88.93	3290.46	27.51	1017.88	16.93	626.24	0.294	6.12	0.309	0.190							
	924	73.53	2720.78	23.95	886.20	23.14	856.33	0.284	5.90	0.326	0.315							
	1041	79.32	2934.91	25.40	939.95	19.02	703.57	0.282	5.86	0.320	0.240							
	1127	77.17	2855.43	24.96	923.46	18.40	680.73	0.275	5.72	0.323	0.238							
	1310	79.32	2934.81	23.86	882.89	14.15	523.43	0.256	5.32	0.301	0.178							
	1407	103.84	3842.01	28.18	1042.49	15.60	577.35	0.308	6.41	0.271	0.150							
	1439	86.65	3206.18	31.53	1166.59	21.80	806.54	0.331	6.88	0.364	0.252							
	1535	69.64	2576.79	27.81	1029.12	26.38	975.95	0.311	6.48	0.399	0.379							
Apr 27 90	721	95.71	3541.10	43.07	1593.77	26.47	979.45	0.416	8.65	0.450	0.277	225.25	2.41	8334.40	89.24	20	69-82	150-520
	752	95.57	3535.97	37.85	1400.50	28.68	1061.06	0.398	8.27	0.396	0.300							
	826	94.05	3479.74	38.10	1409.79	31.10	1150.83	0.406	8.45	0.405	0.331							
	856	89.82	3323.26	44.69	1653.43	31.37	1160.55	0.436	9.08	0.498	0.349							
	931	119.27	4413.02	57.62	2131.90	40.58	1501.51	0.567	11.79	0.483	0.340							
	1032	92.81	3434.03	38.14	1411.33	29.85	1104.38	0.401	8.33	0.411	0.322							
	1110	94.65	3501.94	32.28	1194.32	27.13	1003.63	0.363	7.54	0.341	0.287							

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Table 4 - cont.

	1319	84.90	3141.43	28.51	1054.94	23.46	867.94	0.320	6.65	0.336	0.276							
	1416	82.46	3051.19	26.71	988.44	25.28	935.54	0.315	6.55	0.324	0.307							
Apr 30 90	828	74.45	2754.61	26.01	962.40	25.56	945.56	0.304	6.32	0.349	0.343	227.80	2.01	8428.60	74.37	20	78	140-240
	901	82.25	3043.31	28.01	1036.40	21.91	810.65	0.309	6.42	0.341	0.266							
	934	89.94	3327.74	28.69	1061.68	22.45	830.71	0.322	6.70	0.319	0.250							
	1101	98.09	3629.24	35.76	1322.95	18.35	678.88	0.351	7.30	0.365	0.187							
	1135	86.20	3189.57	29.79	1102.07	23.66	875.50	0.328	6.83	0.346	0.274							
	1255	92.59	3425.89	27.57	1020.23	21.12	781.44	0.314	6.53	0.298	0.228							
	1326	79.85	2954.50	30.95	1145.17	19.72	729.77	0.313	6.51	0.388	0.247							
	1356	79.56	2943.77	26.41	977.13	23.09	854.32	0.302	6.28	0.332	0.290							
	1428	96.24	3561.01	30.88	1142.41	31.29	1157.77	0.373	7.75	0.321	0.325							
May 01 90	749	53.82	1991.47	7.65	282.91	7.50	277.42	0.122	2.54	0.142	0.139	238.39	10.72	8820.28	396.64	20	74-97	105-315
	826	60.69	2245.66	11.42	422.40	4.97	184.02	0.139	2.89	0.188	0.082							
	856	63.78	2359.69	9.90	366.26	5.34	197.44	0.136	2.82	0.155	0.084							
	928	57.20	2116.22	8.87	328.17	7.65	283.15	0.132	2.75	0.155	0.134							
	1114	68.37	2529.60	13.03	482.00	6.79	251.16	0.162	3.37	0.191	0.099							
	1259	75.60	2797.25	14.65	542.14	15.90	588.34	0.212	4.40	0.194	0.210							
	1410	78.22	2893.98	16.33	604.35	9.61	355.61	0.199	4.14	0.209	0.123							
	1537	71.07	2629.70	12.95	478.99	14.68	543.25	0.194	4.03	0.182	0.207							
May 02 90	811	71.63	2650.46	14.32	529.86	9.61	355.39	0.182	3.79	0.200	0.134	238.52	6.57	8825.24	242.94	20	94-100	90-340
	852	66.98	2478.16	16.16	597.93	11.19	414.14	0.193	4.01	0.241	0.167							
	929	65.88	2437.38	18.52	685.36	12.67	468.95	0.209	4.35	0.281	0.192							
	1050	109.29	4043.58	23.42	866.39	13.62	503.81	0.282	5.87	0.214	0.125							
	1126	85.34	3157.70	19.72	729.79	13.58	502.60	0.239	4.96	0.231	0.159							
	1305	91.96	3402.63	21.68	802.10	14.50	536.33	0.259	5.38	0.236	0.158							
	1335	77.02	2849.56	23.90	884.40	13.99	517.51	0.253	5.26	0.310	0.182							
	1410	82.09	3037.48	21.52	796.09	18.45	682.55	0.263	5.46	0.262	0.225							
May 03 90	809	81.34	3009.69	22.30	824.98	12.06	446.38	0.242	5.03	0.274	0.148	233.56	2.55	8641.79	94.20	20	96-100	90-200
	910	65.71	2431.12	18.05	667.92	14.49	536.04	0.213	4.44	0.275	0.220							
	939	75.07	2777.61	19.50	721.40	13.80	510.53	0.228	4.74	0.260	0.184							
	1038	90.52	3349.40	23.03	852.12	12.98	480.19	0.259	5.38	0.254	0.143							
	1109	81.96	3032.58	20.85	771.49	9.76	361.00	0.227	4.71	0.254	0.119							
	1140	72.69	2689.40	18.55	686.46	10.12	374.33	0.207	4.30	0.255	0.139							
	1316	75.18	2781.71	19.11	707.10	12.43	459.86	0.221	4.59	0.254	0.165							
	1347	80.40	2974.64	21.54	796.98	13.20	488.35	0.241	5.02	0.268	0.164							
	1422	77.48	2866.65	16.77	620.43	18.28	676.48	0.233	4.85	0.216	0.236							
May 04 90	815	80.88	2992.72	20.22	748.13	17.47	646.36	0.251	5.22	0.250	0.216	228.87	5.36	8468.26	198.32	20	84-100	80-230
	849	83.74	3098.30	27.75	1026.75	16.96	627.63	0.290	6.04	0.331	0.203							
	920	74.33	2750.28	26.81	992.02	20.01	740.47	0.287	5.98	0.361	0.269							
	1033	76.74	2839.45	24.03	889.16	21.17	783.46	0.280	5.82	0.313	0.276							
	1103	92.95	3439.16	25.94	959.78	16.73	619.03	0.290	6.03	0.279	0.180							
	1339	88.98	3292.18	27.52	1018.25	24.19	894.90	0.322	6.69	0.309	0.272							
	1424	69.94	2587.81	29.00	1072.86	26.23	970.62	0.317	6.60	0.415	0.375							
May 07 90	829	69.42	2568.62	12.85	475.62	8.62	318.76	0.169	3.51	0.185	0.124	112.83	93.67	4174.64	3465.64	21	22-68	100-400
	932	15.89	587.82	3.39	125.55	1.30	48.01	0.038	0.80	0.214	0.082							
	1034	6.77	250.63	0.92	34.18	1.29	47.78	0.016	0.34	0.136	0.191							
	1117	12.38	458.04	2.22	82.13	-0.39	-14.56	0.023	0.47	0.179	-0.032							
	1337	11.24	415.85	1.52	56.29	0.80	29.46	0.022	0.46	0.135	0.071							
	1428	12.13	448.85	1.76	65.26	0.16	6.09	0.022	0.46	0.145	0.014							
May 08 90	829	11.61	429.50	1.77	65.49	-0.51	-18.74	0.019	0.40	0.152	-0.044	46.50	14.07	1720.43	520.59	21	21-36	40-690
	1033	24.95	923.21	2.53	93.79	2.54	93.95	0.048	1.00	0.102	0.102							
	1103	7.91	292.71	-1.10	-40.59	5.86	216.72	0.024	0.51	-0.139	0.740							
	1304	22.98	850.09	2.78	102.88	0.73	26.91	0.040	0.84	0.121	0.032							
	1338	12.26	453.56	1.92	71.02	0.99	36.75	0.026	0.54	0.157	0.081							
	1408	13.06	483.30	1.86	68.87	0.80	29.73	0.026	0.54	0.143	0.062							
	1441	18.69	691.53	2.92	107.87	-0.38	-14.21	0.033	0.68	0.156	-0.021							

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Table 4 - cont.

May 09 90	809	16.26	601.70	1.55	57.41	0.79	29.07	0.028	0.57	0.095	0.048	133.46	116.18	4938.17	4298.59	21	22-41	70-310
	848	11.33	419.32	1.09	40.18	0.14	5.05	0.018	0.37	0.096	0.012							
	925	12.55	464.46	0.48	17.78	0.98	36.42	0.019	0.40	0.038	0.078							
	1042	20.99	776.59	2.00	73.82	0.53	19.45	0.034	0.70	0.095	0.025							
	1126	12.85	475.31	1.07	39.45	0.28	10.21	0.020	0.41	0.083	0.021							
	1254	14.62	540.81	0.89	32.86	0.73	27.11	0.022	0.46	0.061	0.050							
	1324	13.03	482.28	1.48	54.70	-0.09	-3.39	0.021	0.43	0.113	-0.007							
	1355	15.68	580.06	1.48	54.82	0.55	20.47	0.026	0.53	0.094	0.035							
	1426	13.33	493.07	1.58	58.51	-0.24	-8.98	0.021	0.43	0.119	-0.018							
May 10 90	929	123.97	4587.05	29.88	1105.47	22.78	843.03	0.364	7.58	0.241	0.184	233.43	147.40	8636.84	5453.80	21	28-73	100-600
	1028	125.83	4655.73	33.59	1242.93	25.23	933.57	0.394	8.20	0.267	0.201							
	1058	109.16	4038.83	31.09	1150.46	31.83	1177.77	0.389	8.09	0.285	0.292							
	1128	124.23	4596.49	36.32	1343.84	27.16	1004.81	0.414	8.60	0.292	0.219							
	1309	71.36	2640.50	21.82	807.29	15.40	569.88	0.242	5.03	0.306	0.216							
	1339	24.66	912.50	5.62	208.08	5.13	189.69	0.073	1.52	0.228	0.208							
	1410	20.99	776.56	3.55	131.32	0.27	10.13	0.041	0.85	0.169	0.013							
	1529	19.72	729.64	1.88	69.45	0.97	35.88	0.033	0.70	0.095	0.049							
May 11 90	836	12.14	449.09	0.96	35.45	0.25	9.42	0.018	0.38	0.079	0.021	90.85	58.56	3361.52	2166.65	22	14	70-190
	906	12.60	466.12	1.07	39.68	0.42	15.36	0.020	0.42	0.085	0.033							
	936	14.11	522.05	1.16	42.75	0.13	4.94	0.021	0.43	0.082	0.009							
	1044	10.11	374.24	1.07	39.70	0.38	14.06	0.017	0.36	0.106	0.038							
	1115	9.84	364.12	0.93	34.53	0.19	6.86	0.016	0.32	0.095	0.019							
	1357	26.16	967.85	3.42	126.55	0.33	12.08	0.046	0.95	0.131	0.012							
	1427	18.18	672.77	1.89	69.76	-0.17	-6.38	0.028	0.57	0.104	-0.009							
May 14 90	839	57.57	2129.93	12.10	447.57	9.79	362.32	0.157	3.27	0.210	0.170	219.63	10.18	8126.16	376.81			
	930	61.06	2259.18	14.91	551.78	10.16	375.98	0.179	3.73	0.234	0.159							
	1028	72.94	2698.67	14.56	538.68	11.10	410.58	0.190	3.96	0.200	0.152							
	1125	84.83	3138.85	17.96	664.61	8.62	318.93	0.211	4.38	0.212	0.102							
	1252	122.87	4546.35	27.30	1010.27	2.15	79.53	0.273	5.68	0.222	0.017							
	1400	59.86	2214.74	14.73	544.89	15.20	562.33	0.193	4.02	0.246	0.254							
	1519	63.39	2345.38	21.25	786.15	12.22	452.06	0.219	4.55	0.335	0.193							
May 15 90	738	66.74	2469.58	18.19	673.15	6.69	247.39	0.214	4.45	0.194	0.071	215.34	13.53	7967.51	500.76			
	836	55.66	2059.28	10.25	379.33	12.30	454.98	0.155	3.23	0.184	0.221							
	930	52.05	1925.70	11.43	423.03	9.55	353.41	0.147	3.06	0.220	0.184							
	1043	58.59	2167.75	12.36	457.29	10.52	389.38	0.162	3.38	0.211	0.180							
	1327	64.08	2370.96	15.67	579.68	13.14	486.25	0.195	4.05	0.244	0.205							
	1431	63.45	2347.49	14.02	518.84	14.65	542.03	0.191	3.98	0.221	0.231							
May 16 90	750	85.49	3163.29	18.10	669.83	9.88	365.47	0.217	4.51	0.212	0.116	224.45	1.74	8304.65	64.45	21	45	70-375
	827	75.03	2776.11	17.94	663.64	8.36	309.32	0.199	4.15	0.239	0.111							
	914	60.01	2220.22	14.46	534.98	9.46	349.84	0.173	3.60	0.231	0.151							
	1019	71.93	2661.45	14.52	537.20	7.14	264.13	0.174	3.63	0.202	0.099							
	1230	75.00	2775.06	12.98	480.31	7.91	292.66	0.173	3.59	0.173	0.105							
	1304	56.11	2075.96	10.18	376.83	10.13	374.68	0.147	3.06	0.182	0.180							
	1354	71.69	2652.64	10.80	399.71	8.66	320.30	0.161	3.35	0.151	0.121							
	1425	56.92	2106.18	11.21	414.66	8.02	296.79	0.145	3.02	0.197	0.141							
May 17 90	743	69.16	2559.83	11.58	428.42	5.74	212.56	0.151	3.15	0.167	0.083	228.60	1.61	8458.35	59.50	21	52	90-420
	846	83.01	3071.22	14.02	518.65	6.43	237.73	0.181	3.76	0.169	0.077							
	1042	66.52	2461.25	11.05	408.88	8.13	300.67	0.155	3.22	0.166	0.122							
	1122	79.92	2956.93	12.95	479.17	6.14	227.09	0.171	3.55	0.162	0.077							
	1304	73.57	2722.09	13.32	492.86	3.97	146.76	0.158	3.29	0.181	0.054							
	1419	76.28	2822.30	12.66	468.26	4.12	152.37	0.158	3.29	0.166	0.054							
May 18 90	724	59.90	2216.15	5.47	202.38	1.67	61.87	0.096	1.99	0.091	0.028	134.27	95.41	4967.92	3530.10			
	1026	47.11	1743.04	4.52	167.42	0.87	32.17	0.075	1.55	0.096	0.018							

Table 5 - ^{222}Rn progeny data by the Thomas-Tsivoglou method, and as measured by the IWLM MDA-811. Also shown are other environmental variables of interest.

Date 1990	WL(Rn)*	WL(1)$^{+}$	WL(2)$^{++}$	WL(1)/WL(Rn)	WL(2)/WL(Rn)	T (^{o}C)	RH (%)	N (cm^{-3})
Mar 19	0.046±0.005	0.065±0.001	0.079±0.011	1.42±0.17	1.78±0.45	21	40	100-400
Mar 20	0.053±0.004	0.058±0.023	0.094±0.041	1.16±0.53	1.76±0.74	21	38	100-300
Mar 21	0.059±0.005	0.077±0.013	0.057±0.011	1.32±0.24	0.97±0.22	21	51	100-390
Mar 22	0.115±0.012	0.115±0.038	0.114±0.044	1.03±0.32	1.06±0.36	21	57	120-280
Mar 23	0.053±0.011	0.079±0.025	0.054±0.028	1.50±0.46	1.12±0.63	21	49	90-350
Mar 26	0.048±0.008	0.061±0.027	0.048±0.026	1.34±0.75	0.97±0.50	21	46	180-450
Apr 3**	0.299±0.153	0.277±0.187	0.234±0.202	1.00±0.26	0.71±0.41	21	49	300-2.4x10^{4}
Apr 4	0.480±0.013	0.438±0.063	0.568±0.042	0.91±0.13	1.18±0.09	21	48	2.6x10^{4}
Apr 5	0.504±0.011	0.452±0.121	0.591±0.067	0.89±0.24	1.17±0.12	21	46	2.7x10^{4}
Apr 6	0.504±0.013	0.507±0.063	0.579±0.063	1.01±0.13	1.15±0.14	21	51	2.9x10^{4}
Apr 9**	1.143±0.280	1.100±0.242	1.227±0.356	0.97±0.06	1.06±0.09	21	54	60-2.8x10^{4}
Apr 10	1.253±0.026	1.211±0.074	1.450±0.088	0.97±0.06	1.16±0.08	21	54	2.9x10^{4}
Apr 11**	1.315±0.034	1.292±0.053	1.527±0.054	0.98±0.03	1.16±0.06	21	46	2.9x10^{4}
Apr 12	1.358±0.024	1.35±0.08	1.599±0.044	0.99±0.06	1.18±0.03	21	53	2.1x10^{4}-2.8x10^{4}
Apr 18	0.151±0.007	0.199±0.050	0.168±0.044	1.31±0.30	1.10±0.27	10.7	63	80-240
Apr 19	0.277±0.055	0.271±0.089	0.266±0.107	0.96±0.28	0.95±0.29	10.6	61	40-300
Apr 20	0.286±0.032	0.303±0.042	0.339±0.041	1.07±0.16	1.19±0.19	10.7	57	150-240
Apr 23	0.225±0.013	0.240±0.005	0.28±0.054	1.07±0.04	1.23±0.16	22-26	55	90-200
Apr 24	0.351±0.027	0.370±0.038	0.409±0.053	1.05±0.05	1.16±0.09	26	48	100-580
Apr 25	0.412±0.027	0.394±0.048	0.430±0.032	0.96±0.08	1.05±0.08	26	52	150-400
Apr 26	0.292±0.021	0.305±0.019	0.325±0.041	1.05±0.06	1.11±0.13	21-26	32-86	150-210

Cont.

Table 5 - Cont.

Date 1990	WL(Rn)*	WL(1)$^+$	WL(2)$^{++}$	WL(1)/WL(Rn)	WL(2)/WL(Rn)	T (^{o}C)	RH (%)	N (cm^{-3})
Apr 27	0.402±0.07	0.371±0.041	0.429±0.061	0.93±0.07	1.13±0.12	20	69-82	150-520
Apr 30	0.324±0.02	0.311±0.044	0.340±0.046	0.97±0.16	1.05±0.10	20	78	140-240
May 1	0.162±0.033	0.183±0.045	0.188±0.059	1.13±0.22	1.17±0.36	20	74-97	105-315
May 2	0.235±0.033	0.230±0.045	0.238±0.042	0.99±0.17	1.03±0.20	20	94-100	90-340
May 3	0.230±0.015	0.250±0.029	0.243±0.044	1.09±0.12	1.06±0.17	20	96-100	90-200
May 4	0.291±0.022	0.312±0.033	0.330±0.033	1.08±0.10	1.13±0.05	20	84-100	80-230
May 7**	0.048±0.054	0.046±0.034	0.058±0.049	1.16±0.50	1.52±0.96	21	22-68	100-400
May 8	0.031±0.009	0.028±0.014	0.027±0.018	0.93±0.45	0.95±0.62	21	21-36	40-690
May 9	0.023±0.004	0.036±0.020	0.043±0.005	1.63±1.15	1.77±0.54	21	22-41	70-310
May 10**	0.244±0.159	0.251±0.152	0.278±0.183	1.11±0.19	1.09±0.30	21	28-73	100-600
May 11	0.024±0.009	0.037±0.009	0.035±0.028	1.74±0.54	1.52±1.32	22	14	70-190
May 16^a	0.174±0.023	0.736±1.51$^\$$	0.167±0.033	5.48±9.48$^\$$	1.05±0.27	21	45	70-375
May 17^a	0.162±0.010	0.173±0.087	0.193±0.072	0.93±0.60	1.64±0.43	21	52	90-420

Notes: T, RH and N stand, respectively, for temperature, relative humidity, and aerosol concentration. A single value indicates the daily average value. Two values indicate the range of values. However, if there is a large difference between these two values, the range is meant to indicate transient conditions between the indicated initial and final values.

* WL(Rn) stands for the ^{222}Rn progeny Working Level determined by the Thomas-Tsivoglou method.

+,++ ^{222}Rn progeny Working Level as determined by the IWLM MDA-811. WL(1) and WL(2) refer to the first and second determination, respectively.

$ Not included in 'overall' average calculations.

** Tests conducted under transient conditions.

a γ-field present.

Table 6 - Ratio of ^{222}Rn progeny Working Level as determined by the MDA-811, i.e., WL(1) and WL(2), and by the Thomas-Tsivoglou method, WL(Rn).

$\frac{WL(1)}{WL(Rn)}$	$\frac{WL(2)}{WL(Rn)}$	Experimental Conditions in the RTTF
0.96 ± 0.04	1.10 ± 0.16	$T = 21^{\circ}C$, RH ~50%, $N \geq 1.0 \times 10^4$ cm^{-3}
1.11 ± 0.18	1.08 ± 0.12	$T = 10^{\circ}C$, RH ~60%, $N < 500$ cm^{-3}
1.03 ± 0.05	1.14 ± 0.08	$T = 26^{\circ}C$, RH ~50%, $N < 500$ cm^{-3}
1.07 ± 0.06	1.10 ± 0.06	$T = 20^{\circ}C$, RH ~100%, $N < 500$ cm^{-3}
1.29 ± 0.17	1.28 ± 0.39	$T = 21^{\circ}C$, RH ~50%, $N < 500$ cm^{-3}
1.11 ± 0.21	1.19 ± 0.25	All experimental conditions included.

Table 7 - Data by the EDA WLM-30 and by the Thomas-Tsivoglou method.

		WLM30 #A073		Grab samples (Thomas)					
Date	Time	Diff. (WL)	PAEC(Rn) (uJ/m3)	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	$\frac{WL(30)}{WL(Rn)}$	$\frac{cpm}{WL(Rn)}$ $\times 10^{-3}$	$\frac{cpm}{PAEC(Rn)}$ $\times 10^{-3}$
Mar 23 90	8 33	0.019	0.3952	812	0.043	0.885	0.45	1.760	0.085
	9 33	0.036	0.7488	849	0.040	0.834	0.90	3.539	0.170
	10 33	0.043	0.8944	922	0.050	1.031	0.87	3.419	0.164
	11 33	0.047	0.9776	1029	0.043	0.886	1.10	4.349	0.209
	12 33	0.054	1.1232	1232	0.061	1.269	0.89	3.489	0.168
	13 33	0.06	1.248	1310	0.055	1.151	1.08	4.272	0.205
	14 33	0.064	1.3312	1344	0.070	1.454	0.92	3.608	0.173
	15 33	0.062	1.2896	1431	0.065	1.353	0.95	3.756	0.181
		0.048	1.001		0.053	1.108			
		0.014330	0.298071		0.010581	0.220091			
Mar 26 90	7 33	0.038	0.7904	816	0.055	1.152	0.69	2.704	0.130
	8 33	0.038	0.7904	853	0.039	0.805	0.98	3.867	0.186
	9 33	0.038	0.7904	928	0.037	0.764	1.03	4.076	0.196
	10 33	0.037	0.7696	1033	0.039	0.809	0.95	3.747	0.180
	11 33	0.039	0.8112	1109	0.052	1.082	0.75	2.953	0.142
	12 33	0.04	0.832	1301	0.052	1.086	0.77	3.017	0.145
	13 33	0.045	0.936	1335	0.056	1.161	0.81	3.176	0.153
	14 33	0.049	1.0192	1416	0.055	1.137	0.90	3.532	0.170
	15 33	0.051	1.0608		0.048	1.000			
		0.042	0.867		0.007825	0.162766			
		0.004988	0.103768						
Apr 03 90	8 48	0.076	1.5808	815	0.060	1.24	1.27	5.007	0.241
	9 48	0.236	4.9088	902	0.102	2.11	2.32	9.160	0.440
	10 48	0.388	8.0704	934	0.238	4.96	1.63	6.413	0.308
	11 48	0.462	9.6096	1049	0.391	8.14	1.18	4.654	0.224
	12 48	0.486	10.1088	1125	0.415	8.63	1.17	4.618	0.222
	13 48	0.493	10.2544	1349	0.451	9.38	1.09	4.306	0.207
	14 48	0.507	10.5456	1424	0.437	9.08	1.16	4.576	0.220
	15 48	0.513	10.6704		0.299	6.219			
		0.395	8.219		0.152960	3.181583			
		0.148295	3.084550						
Apr 04 90	8 48	0.548	11.3984	824	0.494	10.28	1.11	4.368	0.210
	9 48	0.548	11.3984	905	0.505	10.51	1.08	4.272	0.205
	10 48	0.548	11.3984	1032	0.471	9.79	1.16	4.587	0.221
	11 48	0.548	11.3984	1109	0.466	9.68	1.18	4.637	0.223
	12 48	0.552	11.4816	1309	0.485	10.08	1.14	4.489	0.216
	13 48	0.552	11.4816	1338	0.470	9.77	1.18	4.631	0.223
	14 48	0.549	11.4192	1419	0.478	9.93	1.15	4.530	0.218
	15 48	0.55	11.44	1533	0.473	9.84	1.16	4.580	0.220
	16 48	0.549	11.4192		0.480	9.986			
		0.549	11.426		0.012874	0.267780			
		0.001563	0.032520						
Apr 05 90	8 48	0.578	12.0224	815	0.517	10.76	1.12	4.403	0.212
	9 48	0.584	12.1472	851	0.524	10.90	1.11	4.389	0.211
	10 48	0.583	12.1264	929	0.504	10.48	1.16	4.559	0.219
	11 48	0.582	12.1056	1035	0.492	10.23	1.18	4.662	0.224
	12 48	0.583	12.1264	1117	0.512	10.66	1.14	4.483	0.216

Cont.

Table 7 - cont.

	13 48	0.582	12.1056	1301	0.499	10.39	1.17	4.592	0.221
	14 48	0.581	12.0848	1339	0.490	10.20	1.19	4.669	0.224
	15 48	0.581	12.0848	1421	0.498	10.36	1.17	4.597	0.221
		0.582	12.100		0.505	10.497			
		0.001713	0.035649		0.011420	0.237542			
Apr 06 90	8 48	0.578	12.0224	814	0.520	10.83	1.11	4.375	0.210
	9 48	0.581	12.0848	849	0.509	10.59	1.14	4.496	0.216
	10 48	0.581	12.0848	924	0.484	10.06	1.20	4.734	0.228
	11 48	0.582	12.1056	1041	0.510	10.61	1.14	4.495	0.216
	12 48	0.582	12.1056	1115	0.502	10.45	1.16	4.566	0.220
	13 48	0.578	12.0224	1257	0.512	10.64	1.13	4.450	0.214
	14 48	0.574	11.9392	1340	0.515	10.72	1.11	4.390	0.211
	15 48	0.567	11.7936	1415	0.482	10.02	1.18	4.637	0.223
		0.578	12.020		0.504	10.489			
		0.004833	0.100529		0.013401	0.278747			
Apr 10 90	9 12	0.831	17.2848	923	1.261	26.232	0.66	2.596	0.125
	10 12	1.235	25.688	1030	1.269	26.401	0.97	3.834	0.184
	11 12	1.34	27.872	1104	1.200	24.951	1.12	4.401	0.212
	12 12	1.368	28.4544	1256	1.304	27.122	1.05	4.134	0.199
	13 12	1.378	28.6624	1335	1.246	25.918	1.11	4.357	0.209
	14 12	1.389	28.8912	1426	1.230	25.584	1.13	4.449	0.214
	15 12	1.391	28.9328	1525	1.219	25.363	1.14	4.495	0.216
	16 12	1.399	29.0992	1710	1.259	26.190	1.11	4.378	0.210
	17 12	1.4	29.12	1744	1.250	25.990	1.12	4.415	0.212
	18 12	1.403	29.1824	1819	1.252	26.034	1.12	4.417	0.212
	19 12	1.405	29.224	1852	1.290	26.838	1.09	4.290	0.206
	20 12	1.408	29.2864	1928	1.251	26.027	1.13	4.433	0.213
		1.320916	27.64146	2000	1.258	26.159	1.06	4.163	0.200
		0.156992	3.265450		1.252991	26.06221			
					0.026249	0.545998			
Apr 11 90	7 12	1.444	30.0352	814	1.277	26.553	1.13	4.457	0.214
	8 12	1.449	30.1392	848	1.290	26.823	1.12	4.427	0.213
	9 12	1.451	30.1808	928	1.267	26.347	1.15	4.513	0.217
	10 12	1.457	30.3056	1035	1.375	28.606	1.06	4.174	0.201
	11 12	1.467	30.5136	1108	1.341	27.897	1.09	4.310	0.207
	12 12	1.477	30.7216	1259	1.328	27.625	1.11	4.382	0.211
	13 12	1.475	30.68	1322	1.288	26.792	1.15	4.512	0.217
	14 12	1.484	30.8672	1404	1.340	27.882	1.11	4.362	0.210
	15 12	1.482	30.8256	1437	1.326	27.571	1.12	4.405	0.212
		1.465111	30.47431		1.314611	27.34392			
		0.014356	0.298607		0.034044	0.708121			
Apr 12 90	7 12	1.506	31.3248	810	1.376	28.629	1.09	4.311	0.207
	8 12	1.512	31.4496	843	1.363	28.349	1.11	4.371	0.210
	9 12	1.503	31.2624	922	1.376	28.619	1.09	4.304	0.207
	10 12	1.505	31.304	1041	1.362	28.328	1.11	4.354	0.209
	11 12	1.498	31.1584.	1114	1.311	27.275	1.14	4.501	0.216
	12 12	1.407	29.2656		1.357695	28.24005			
		1.4085	30.9608		0.024008	0.455874			
		0.036682	0.762989						
Apr 18 90	7 17	0.097	2.0176	754	0.153	3.189	0.63	2.493	0.120
	8 17	0.102	2.1216	832	0.153	3.186	0.67	2.623	0.126

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Table 7 - cont.

	9 17	0.104	2.1632	907	0.151	3.136	0.69	2.718	0.131
	10 17	0.11	2.288	937	0.163	3.396	0.67	2.654	0.128
	11 17	0.11	2.288	1035	0.153	3.174	0.72	2.840	0.137
	12 17	0.109	2.2672	1107	0.153	3.190	0.71	2.801	0.135
	13 17	0.108	2.2464	1137	0.136	2.835	0.79	3.122	0.150
	14 17	0.106	2.2048	1306	0.157	3.270	0.67	2.657	0.128
	15 17	0.107	2.2256	1343	0.143	2.978	0.75	2.944	0.142
		0.105888	2.202488	1419	0.152	3.169	0.00	2.738	0.132
		0.004039	0.084030		0.151559	3.152447			
					0.006950	0.144566			
Apr 19 90	7 17	0.157	3.2656	817	0.211	4.387	0.74	2.933	0.141
	8 17	0.159	3.3072	853	0.201	4.190	0.79	3.110	0.149
	9 17	0.159	3.3072	926	0.217	4.518	0.73	2.884	0.139
	10 17	0.164	3.4112	1105	0.248	5.165	0.66	2.602	0.125
	11 17	0.204	4.2432	1135	0.310	6.457	0.66	2.589	0.124
	12 17	0.258	5.3664	1250	0.361	7.514	0.71	2.814	0.135
	13 17	0.27	5.616	1323	0.324	6.736	0.83	3.285	0.158
	14 17	0.252	5.2416	1354	0.314	6.527	0.80	3.164	0.152
	15 17	0.23	4.784	1432	0.308	6.405	0.75	2.943	0.141
		0.205888	4.282488		0.277248	5.766760			
		0.044819	0.932240		0.054975	1.143499			
Apr 20 90	8 17	0.213	4.4304	826	0.277	5.764	0.77	3.028	0.146
	9 17	0.213	4.4304	856	0.268	5.570	0.80	3.134	0.151
	10 17	0.215	4.472	930	0.270	5.607	0.80	3.142	0.151
	11 17	0.219	4.5552	1034	0.270	5.624	0.81	3.191	0.153
	12 17	0.222	4.6176	1118	0.264	5.496	0.84	3.310	0.159
	13 17	0.23	4.784	1259	0.288	5.997	0.80	3.143	0.151
	14 17	0.237	4.9296	1407	0.283	5.878	0.84	3.304	0.159
	15 17	0.262	5.4496	1536	0.367	7.642	0.71	2.810	0.135
	16 17	0.292	6.0736		0.285925	5.947259			
		0.233666	4.860266		0.031696	0.659291			
		0.025350	0.527298						
Apr 23 90	12 17	0.177	3.6816	1309	0.210	4.360	0.84	3.327	0.160
	13 17	0.187	3.8896	1341	0.223	4.633	0.84	3.308	0.159
	14 17	0.206	4.2848	1415	0.222	4.622	0.93	3.653	0.176
	15 17	0.236	4.9088	1452	0.247	5.129	0.96	3.771	0.181
	16 17	0.271	5.6368		0.225278	4.685785			
		0.2154	4.48032		0.013367	0.278036			
		0.034308	0.713606						
Apr 24 90	7 17	0.337	7.0096	823	0.316	6.582	1.06	4.196	0.202
	8 17	0.331	6.8848	905	0.337	7.019	0.98	3.865	0.186
	9 17	0.328	6.8224	1025	0.324	6.745	1.01	3.985	0.192
	10 17	0.33	6.864	1058	0.334	6.952	0.99	3.890	0.187
	11 17	0.347	7.2176	1131	0.347	7.212	1.00	3.943	0.190
	12 17	0.364	7.5712	1306	0.373	7.766	0.97	3.841	0.185
	13 17	0.382	7.9456	1343	0.382	7.954	1.00	3.936	0.189
	14 17	0.405	8.424	1422	0.394	8.197	1.03	4.049	0.195
	15 17	0.423	8.7984		0.351120	7.303299			
		0.360777	7.504177		0.026773	0.556891			
		0.033252	0.691651						
Apr 25 90	7 17	0.471	9.7968	815	0.437	9.097	1.08	4.243	0.204

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Table 7 - cont.

	8 17	0.456	9.4848	849	0.419	8.709	1.09	4.291	0.206
	9 17	0.455	9.464	925	0.436	9.071	1.04	4.111	0.198
	10 17	0.454	9.4432	1044	0.451	9.374	1.01	3.969	0.191
	11 17	0.45	9.36	1126	0.426	8.852	1.06	4.166	0.200
	12 17	0.435	9.048	1302	0.393	8.172	1.11	4.362	0.210
	13 17	0.413	8.5904	1339	0.395	8.226	1.04	4.115	0.198
	14 17	0.393	8.1744	1415	0.393	8.171	1.00	3.942	0.190
	15 17	0.371	7.7168	1529	0.357	7.430	1.04	4.092	0.197
	16 17	0.346	7.1968		0.411867	8.566840			
		0.4244	8.82752		0.027809	0.578444			
		0.039830	0.828466						
Apr 26 90	7 17	0.29	6.032	822	0.291	6.044	1.00	3.932	0.189
	8 17	0.29	6.032	855	0.294	6.122	0.99	3.882	0.187
	9 17	0.295	6.136	924	0.284	5.900	1.04	4.098	0.197
	10 17	0.294	6.1152	1041	0.282	5.857	1.04	4.114	0.198
	11 17	0.282	5.8656	1127	0.275	5.716	1.03	4.043	0.194
	12 17	0.267	5.5536	1310	0.256	5.316	1.04	4.116	0.198
	13 17	0.268	5.5744	1407	0.308	6.409	0.87	3.427	0.165
	14 17	0.306	6.3648	1439	0.331	6.876	0.93	3.647	0.175
	15 17	0.334	6.9472	1535	0.311	6.475	1.07	4.227	0.203
	16 17	0.336	6.9888		0.292279	6.079406			
		0.2962	6.16096		0.020902	0.434772			
		0.022453	0.467032						
Apr 27 90	6 17	0.447	9.2976	721	0.416	8.652	1.07	4.234	0.204
	7 17	0.437	9.0896	752	0.398	8.269	1.10	4.331	0.208
	8 17	0.435	9.048	826	0.406	8.451	1.07	4.218	0.203
	9 17	0.454	9.4432	856	0.436	9.076	1.04	4.099	0.197
	10 17	0.44	9.152	931	0.567	11.788	0.78	3.059	0.147
	11 17	0.404	8.4032	1032	0.401	8.332	1.01	3.974	0.191
	12 17	0.379	7.8832	1110	0.363	7.540	1.05	4.119	0.198
	13 17	0.348	7.2384	1319	0.320	6.649	1.09	4.289	0.206
	14 17	0.335	6.968	1416	0.315	6.549	1.06	4.192	0.202
	15 17	0.331	6.8848		0.402270	8.367229			
		0.401	8.3408		0.070300	1.462246			
		0.046320	0.963468						
Apr 30 90	7 17	0.325	6.76	828	0.304	6.324	1.07	4.212	0.202
	8 17	0.329	6.8432	901	0.309	6.419	1.07	4.200	0.202
	9 17	0.335	6.968	934	0.322	6.698	1.04	4.099	0.197
	10 17	0.347	7.2176	1101	0.351	7.300	0.99	3.896	0.187
	11 17	0.348	7.2384	1135	0.328	6.827	1.06	4.177	0.201
	12 17	0.341	7.0928	1255	0.314	6.533	1.09	4.278	0.206
	13 17	0.329	6.8432	1326	0.313	6.509	1.05	4.143	0.199
	14 17	0.319	6.6352	1356	0.302	6.284	1.06	4.160	0.200
	15 17	0.321	6.6768	1420	0.373	7.749	0.86	3.395	0.163
		0.332666	6.919466		0.323947	6.738107			
		0.010132	0.210755		0.022215	0.462085			
May 01 90	7 17	0.112	2.3296	749	0.122	2.541	0.92	3.612	0.174
	8 17	0.116	2.4128	826	0.139	2.891	0.83	3.289	0.158
	9 17	0.126	2.6208	856	0.136	2.825	0.93	3.656	0.176
	10 17	0.129	2.6832	928	0.132	2.755	0.97	3.838	0.184
	11 17	0.148	3.0784	1114	0.162	3.366	0.91	3.603	0.173
	12 17	0.185	3.848	1259	0.212	4.400	0.87	3.446	0.166

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Table 7 - cont.

	13 17	0.194	4.0352	1410	0.199	4.145	0.97	3.836	0.184
	14 17	0.19	3.952	1537	0.194	4.028	0.98	3.866	0.186
	15 17	0.196	4.0768		0.161960	3.368781			
	16 17	0.201	4.1808		0.032634	0.678797			
		0.1597	3.32176						
		0.034868	0.725264						
May 02 90	8 17	0.17	3.536	811	0.182	3.791	0.93	3.675	0.177
	9 17	0.187	3.8896	852	0.193	4.009	0.97	3.823	0.184
	10 17	0.201	4.1808	929	0.209	4.350	0.96	3.787	0.182
	11 17	0.21	4.368	1050	0.282	5.869	0.74	2.932	0.141
	12 17	0.225	4.68	1126	0.239	4.964	0.94	3.715	0.179
	13 17	0.241	5.0128	1305	0.259	5.383	0.93	3.669	0.176
	14 17	0.261	5.4288	1335	0.253	5.258	1.03	4.068	0.196
	15 17	0.27	5.616	1410	0.263	5.461	1.03	4.052	0.195
		0.220625	4.589		0.234884	4.885606			
		0.032965	0.685685		0.033755	0.702120			
May 03 90	7 17	0.213	4.4304	809	0.242	5.032	0.88	3.469	0.167
	8 17	0.216	4.4928	910	0.213	4.437	1.01	3.989	0.192
	9 17	0.217	4.5136	939	0.228	4.737	0.95	3.754	0.180
	10 17	0.221	4.5968	1038	0.259	5.377	0.85	3.368	0.162
	11 17	0.218	4.5344	1109	0.227	4.714	0.96	3.790	0.182
	12 17	0.213	4.4304	1140	0.207	4.300	1.03	4.059	0.195
	13 17	0.218	4.5344	1316	0.221	4.592	0.99	3.891	0.187
	14 17	0.237	4.9296	1347	0.241	5.020	0.98	3.869	0.186
	15 17	0.242	5.0336	1422	0.233	4.848	1.04	4.091	0.197
		0.221666	4.610666		0.230006	4.784129			
		0.009888	0.205675		0.014958	0.311129			
May 04 90	7 17	0.278	5.7824	815	0.251	5.222	1.11	4.362	0.210
	8 17	0.272	5.6576	849	0.290	6.040	0.94	3.691	0.177
	9 17	0.29	6.032	920	0.287	5.976	1.01	3.977	0.191
	10 17	0.3	6.24	1033	0.280	5.824	1.07	4.221	0.203
	11 17	0.309	6.4272	1103	0.290	6.027	1.07	4.201	0.202
	12 17	0.348	7.2384	1339	0.322	6.688	1.08	4.264	0.205
	13 17	0.354	7.3632	1424	0.317	6.595	1.12	4.399	0.211
	14 17	0.347	7.2176		0.291020	6.053230			
	15 17	0.333	6.9264		0.021854	0.454579			
		0.314555	6.542755						
		0.029926	0.622465						
May 07 90	7 17	0.147	3.0576	829	0.169	3.512	0.87	3.430	0.165
	8 17	0.14	2.912	932	0.038	0.799	3.64	14.358	0.690
	9 17	0.083	1.7264	1034	0.016	0.343	5.04	19.845	0.954
	10 17	0.038	0.7904	1117	0.023	0.469	1.69	6.642	0.319
	11 17	0.022	0.4576	1337	0.022	0.463	0.99	3.894	0.187
	12 17	0.017	0.3536	1428	0.022	0.459	0.77	3.037	0.146
	13 17	0.016	0.3328		0.048433	1.007408			
	14 17	0.016	0.3328		0.054272	1.128869			
	15 17	0.015	0.312						
		0.054888	1.141688						
		0.051571	1.072694						
May 08 90	7 17	0.013	0.2704	829	0.019	0.396	0.68	2.690	0.129
	8 17	0.013	0.2704	1033	0.048	0.999	0.27	1.067	0.051

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Table 7 - cont.

	9 17	0.019	0.3952	1103	0.024	0.508	0.78	3.064	0.147
	10 17	0.027	0.5616	1304	0.040	0.842	0.67	2.628	0.126
	11 17	0.027	0.5616	1338	0.026	0.542	1.04	4.081	0.196
	12 17	0.027	0.5616	1408	0.026	0.539	1.04	4.109	0.198
	13 17	0.026	0.5408	1441	0.033	0.678	0.80	3.142	0.151
	14 17	0.028	0.5824		0.030931	0.643373			
	15 17	0.03	0.624		0.009400	0.195533			
		0.023333	0.485333						
		0.006200	0.128967						
May 09 90	7 17	0.019	0.3952	809	0.028	0.573	0.69	2.718	0.131
	8 17	0.019	0.3952	848	0.018	0.368	1.07	4.233	0.204
	9 17	0.02	0.416	925	0.019	0.396	1.05	4.141	0.199
	10 17	0.02	0.416	1042	0.034	0.701	0.59	2.339	0.112
	11 17	0.02	0.416	1126	0.020	0.409	1.02	4.008	0.193
	12 17	0.019	0.3952	1254	0.022	0.463	0.85	3.359	0.162
	13 17	0.02	0.416	1324	0.021	0.428	0.97	3.830	0.184
	14 17	0.023	0.4784	1355	0.026	0.535	0.89	3.523	0.169
	15 17	0.046	0.9568	1426	0.021	0.433	2.21	8.699	0.418
		0.022888	0.476088		0.023002	0.478455			
		0.008252	0.171645		0.004813	0.100130			
May 10 90	8 17	0.305	6.344	929	0.364	7.577	0.84	3.299	0.159
	9 17	0.35	7.28	1028	0.394	8.199	0.89	3.498	0.168
	10 17	0.39	8.112	1058	0.389	8.091	1.00	3.950	0.190
	11 17	0.414	8.6112	1128	0.414	8.602	1.00	3.944	0.190
	12 17	0.424	8.8192	1309	0.242	5.027	1.75	6.912	0.332
	13 17	0.27	5.616	1339	0.073	1.520	3.70	14.560	0.700
	14 17	0.106	2.2048	1410	0.041	0.845	2.61	10.277	0.494
	15 17	0.043	0.8944	1529	0.033	0.696	1.29	5.066	0.244
	16 17	0.027	0.5616		0.243734	5.069671			
		0.258777	5.382577		0.158792	3.302884			
		0.150117	3.122445						
May 11 90	7 17	0.012	0.2496	836	0.018	0.381	0.66	2.583	0.124
	8 17	0.012	0.2496	906	0.020	0.415	0.60	2.369	0.114
	9 17	0.012	0.2496	936	0.021	0.434	0.57	2.264	0.109
	10 17	0.013	0.2704	1044	0.017	0.359	0.75	2.965	0.143
	11 17	0.014	0.2912	1115	0.016	0.324	0.90	3.545	0.170
	12 17	0.016	0.3328	1357	0.046	0.946	0.35	1.385	0.067
	13 17	0.017	0.3536	1427	0.028	0.575	0.62	2.423	0.116
	14 17	0.018	0.3744		0.023588	0.490639			
	15 17	0.019	0.3952		0.009631	0.200331			
		0.014777	0.307377						
		0.002615	0.054397						
May 14 90	7 17	0.15	3.12	839	0.157	3.270	0.95	3.760	0.181
	8 17	0.154	3.2032	930	0.179	3.728	0.86	3.385	0.163
	9 17	0.161	3.3488	1028	0.190	3.960	0.85	3.332	0.160
	10 17	0.171	3.5568	1125	0.211	4.382	0.81	3.198	0.154
	11 17	0.183	3.8064	1252	0.273	5.680	0.67	2.640	0.127
	12 17	0.201	4.1808	1400	0.193	4.016	1.04	4.102	0.197
	13 17	0.212	4.4096	1519	0.219	4.549	0.97	3.819	0.184
	14 17	0.209	4.3472		0.203191	4.226386			
	15 17	0.218	4.5344		0.034093	0.709141			
	16 17	0.229	4.7632						

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Table 7 - cont.

		0.1888	3.92704						
		0.027209	0.565958						
May 15 90	7 17	0.173	3.5984	738	0.214	4.447	0.81	3.188	0.153
	8 17	0.164	3.4112	836	0.155	3.228	1.06	4.163	0.200
	9 17	0.16	3.328	930	0.147	3.063	1.09	4.281	0.206
	10 17	0.162	3.3696	1043	0.162	3.376	1.00	3.932	0.189
	11 17	0.165	3.432	1327	0.195	4.046	0.85	3.342	0.161
	12 17	0.171	3.5568	1431	0.191	3.976	0.89	3.525	0.169
	13 17	0.189	3.9312		0.177376	3.689433			
	14 17	0.206	4.2848		0.023934	0.497839			
	15 17	0.213	4.4304						
		0.178111	3.704711						
		0.018704	0.389063						
May 16 90	7 17	0.192	3.9936	750	0.217	4.508	0.89	3.490	0.168
	8 17	0.184	3.8272	827	0.199	4.149	0.92	3.634	0.175
	9 17	0.177	3.6816	914	0.173	3.603	1.02	4.026	0.194
	10 17	0.171	3.5568	1019	0.174	3.627	0.98	3.864	0.186
	11 17	0.168	3.4944	1230	0.173	3.590	0.97	3.835	0.184
	12 17	0.16	3.328	1304	0.147	3.062	1.09	4.282	0.206
	13 17	0.154	3.2032	1354	0.161	3.347	0.96	3.770	0.181
	14 17	0.148	3.0784	1425	0.145	3.025	1.02	4.010	0.193
	15 17	0.142	2.9536		0.173747	3.613943			
		0.166222	3.457422		0.022866	0.475622			
		0.015739	0.327379						
May 17 90	7 17	0.127	2.6416	743	0.151	3.149	0.84	3.305	0.159
	8 17	0.134	2.7872	846	0.181	3.756	0.74	2.924	0.141
	9 17	0.139	2.8912	1042	0.155	3.222	0.90	3.536	0.170
	10 17	0.148	3.0784	1122	0.171	3.555	0.87	3.412	0.164
	11 17	0.147	3.0576	1304	0.158	3.289	0.93	3.663	0.176
	12 17	0.146	3.0368	1419	0.158	3.289	0.92	3.638	0.175
	13 17	0.142	2.9536		0.162332	3.376516			
	14 17	0.137	2.8496		0.010128	0.210666			
	15 17	0.135	2.808						
		0.139444	2.900444						
		0.006584	0.136961						
May 18 90	6 17	0.062	1.2896						
	7 17	0.061	1.2688	724	0.096	1.989	0.65	2.554	0.123
	8 17	0.057	1.1856						
	9 17	0.055	1.144						
	10 17	0.054	1.1232	1026	0.075	1.554	0.82	3.218	0.155
		0.0578	1.20224		0.085168	1.771498			
		0.003187	0.066299		0.010474	0.217876			

Table 8 - Performance of the EDA WLM-30 under various experimental conditions

Date 1990	$\frac{WL(30)}{WL(Rn)} = f$	$\frac{cpm(30)}{WL(Rn)} = CF(Rn)$ $\times 10^{-3}$	$\frac{cpm(30)}{PAEC(Rn)} = CF'(Rn)$ $\times 10^{-3}$	T (^{o}C)	RH (%)	N (cm^{-3})	Remarks
Mar 23-26	0.91±0.12	3.57±0.49	0.17±0.02	21	34-50	90-450	X
Apr 4-6	1.15±0.03	4.52±0.12	0.22±0.01	21	46-52	2.4×10^4-2.9×10^4	
Apr 10-12	1.11±0.03	4.37±0.10	0.21±0.05	21	45-53	2.1×10^4-3.0×10^4	X
Apr 18-20	0.74±0.06	2.94±0.25	0.14±0.01	-10	53-69	40-300	X
Apr 23-26	1.01±0.06	3.97±0.25	0.19±0.01	-25	49-60	90-580	X
Apr 27-May 1	1.01±0.09	3.98±0.36	0.19±0.02	-20	74-82	105-520	XX
May 1-4	0.98±0.08	3.88±0.32	0.19±0.01	20	93-100	80-340	X
May 11	0.64±0.17	2.50±0.66	0.12±0.03	-22	12-16	70-150	X
May 14-17	0.92±0.10	3.65±0.46	0.17±0.02	21	39-53	70-420	

Note: cpm(30) and WL(30) stand for counts per minute and Working Level measured by the EDA WLM-30.
The Working Level determined by the Thomas-Tsivoglou method is denoted by WL(Rn).
The values indicated for RH and N are minimum and maximum values measured during the day

Table 9 - Data by the Thomas-Tsivoglou method and according to the Pylon WL-1000C.

	Grab samples (Thomas)			PYLON (1000C)			
Date	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	Time	WL(1000C)	PAEC(1000C) (uJ/m3)	WL(1000C) / WL(Rn)
Mar 19 90	1120	0.041	0.85	1100	0.0396	0.824	0.97
	1315	0.052	1.07	1300	0.0525	1.092	1.02
Mar 20 90	813	0.056	1.18	800	0.0419	0.872	0.74
	909	0.051	1.06	856	0.0576	1.198	1.13
	1037	0.054	1.13	1026	0.0457	0.951	0.84
	1125	0.046	0.96	1115	0.0441	0.917	0.96
	1303	0.057	1.19	1252	0.0549	1.142	0.96
	1347	0.050	1.05	1338	0.0532	1.107	1.05
				1414	0.0681	1.416	
				1441	0.0685	1.425	
Mar 21 90	819	0.052	1.08	808	0.0811	1.687	1.56
	904	0.057	1.18	855	0.0741	1.541	1.31
	1415	0.060	1.25	1404	0.0649	1.350	1.08
	1528	0.067	1.38	1429	0.071	1.477	1.07
				1519	0.0738	1.535	
Mar 22 90	828	0.104	2.16	809	0.0906	1.884	0.87
	902	0.104	2.17	852	0.0968	2.013	0.93
	934	0.096	2.00	918	0.1024	2.130	1.07
	1121	0.118	2.45	1034	0.1093	2.273	0.93
	1257	0.114	2.38	1110	0.1085	2.257	0.95
	1358	0.125	2.59	1248	0.1225	2.548	0.98
	1433	0.124	2.59	1344	0.1244	2.588	1.00
	1533	0.136	2.83	1413	0.1238	2.575	0.91
				1524	0.1249	2.598	
Mar 23 90	812	0.043	0.88	802	0.0556	1.156	1.31
	849	0.040	0.83	840	0.0552	1.148	1.38
	922	0.050	1.03	913	0.0629	1.308	1.27
	1029	0.043	0.89	1020	0.0621	1.292	1.46
	1232	0.061	1.27	1223	0.0653	1.358	1.07
	1310	0.055	1.15	1300	0.068	1.414	1.23
	1344	0.070	1.45	1331	0.0786	1.635	1.12
	1431	0.065	1.35	1422	0.0888	1.847	1.37
Mar 26 90	816	0.055	1.15	807	0.0443	0.921	0.80
	853	0.039	0.81	844	0.0507	1.055	1.31
	928	0.037	0.76	919	0.0522	1.086	1.42
	1033	0.039	0.81	1024	0.0456	0.948	1.17
	1109	0.052	1.08	1100	0.0461	0.959	0.89
	1301	0.052	1.09	1252	0.0509	1.059	0.97
	1335	0.056	1.16	1326	0.0553	1.150	0.99
	1416	0.055	1.14	1407	0.0607	1.263	1.11
Apr 03 90	815	0.060	1.24	805	0.0557	1.159	0.93
	902	0.102	2.11	854	0.0524	1.090	0.52
	934	0.238	4.96	921	0.1548	3.220	0.65
	1049	0.391	8.14	1040	0.382	7.946	0.98
	1125	0.415	8.63	1116	0.4178	8.690	1.01
	1349	0.451	9.38	1415	0.3816	7.937	0.85
	1424	0.437	9.08				
Apr 04 90	824	0.494	10.28	815	0.4092	8.511	0.83
	905	0.505	10.51	855	0.308	6.406	0.61
	1032	0.471	9.79	1023	0.4385	9.121	0.93

Cont.

Table 9 - cont.

	1109	0.466	9.68	1100	0.514	10.691	1.10
	1309	0.485	10.08	1300	0.2956	6.148	0.61
	1338	0.470	9.77	1328	0.4571	9.508	0.97
	1419	0.478	9.93	1410	0.4498	9.356	0.94
	1533	0.473	9.84	1523	0.4198	8.732	0.89
Apr 05 90	815	0.517	10.76	806	0.3878	8.066	0.75
	851	0.524	10.90	842	0.467	9.714	0.89
	929	0.504	10.48	920	0.4842	10.071	0.96
	1035	0.492	10.23	1026	0.4951	10.298	1.01
	1117	0.512	10.66	1108	0.4916	10.225	0.96
	1301	0.499	10.39	1252	0.4883	10.157	0.98
	1339	0.490	10.20	1326	0.5132	10.675	1.05
	1421	0.498	10.36	1412	0.4793	9.969	0.96
Apr 06 90	814	0.520	10.83	801	0.4889	10.169	0.94
	849	0.509	10.59	840	0.4956	10.308	0.97
	924	0.484	10.06	915	0.4899	10.190	1.01
	1041	0.510	10.61	1031	0.4932	10.259	0.97
	1115	0.502	10.45	1106	0.495	10.296	0.99
	1257	0.512	10.64	1248	0.4579	9.524	0.89
	1340	0.515	10.72	1330	0.5278	10.978	1.02
	1415	0.482	10.02	1406	0.4273	8.888	0.89
Apr 09 90	1129	0.662	13.78	1120	0.4044	8.412	0.61
	1300	1.248	25.96	1250	1.1854	24.656	0.95
	1335	1.306	27.16	1324	1.31	27.248	1.00
	1417	1.357	28.22	1408	1.2835	26.697	0.95
Apr 10 90	923	1.261	26.23	913	1.1515	23.951	0.91
	1030	1.269	26.40	1020	1.1534	23.991	0.91
	1104	1.200	24.95	1055	1.1523	23.968	0.96
	1256	1.304	27.12	1247	1.2246	25.472	0.94
	1335	1.246	25.92	1325	1.2424	25.842	1.00
	1426	1.230	25.58	1417	1.146	23.837	0.93
	1525	1.219	25.36	1530	1.2613	26.235	1.03
	1710	1.259	26.19	1700	1.2539	26.081	1.00
	1744	1.250	25.99	1735	1.2377	25.744	0.99
	1819	1.252	26.03	1810	1.1708	24.353	0.94
	1852	1.290	26.84	1843	1.1391	23.693	0.88
	1928	1.251	26.03	1916	1.1391	23.693	0.91
	2000	1.258	26.16	1951	1.1185	23.265	0.89
Apr 11 90	814	1.277	26.55	805	1.3517	28.115	1.06
	848	1.290	26.82	839	1.3095	27.238	1.02
	928	1.267	26.35	919	1.3266	27.593	1.05
	1035	1.375	28.61	1026	1.2934	26.903	0.94
	1108	1.341	27.90	1058	1.1824	24.594	0.88
	1259	1.328	27.62	1250	0.897	18.658	0.68
	1322	1.288	26.79	1323	1.3297	27.658	1.03
	1404	1.340	27.88	1355	1.3182	27.419	0.98
	1437	1.326	27.57	1428	0.7909	16.451	0.60
Apr 12 90	810	1.376	28.63	801	1.3739	28.577	1.00
	843	1.363	28.35	834	1.3241	27.541	0.97
	922	1.376	28.62	913	1.1582	24.091	0.84
	1041	1.362	28.33	1032	1.126	23.421	0.83
	1114	1.311	27.27	1105	1.3576	28.238	1.04
Apr 18 90	754	0.153	3.19	745	0.1707	3.551	1.11
	832	0.153	3.19	823	0.1796	3.736	1.17
	907	0.151	3.14	855	0.1786	3.715	1.18
	937	0.163	3.40	931	0.188	3.910	1.15

Cont.

Table 9 - cont.

	1035	0.153	3.17	1024	0.1723	3.584	1.13
	1107	0.153	3.19	1058	0.1776	3.694	1.16
	1137	0.136	2.84	1128	0.1779	3.700	1.31
	1306	0.157	3.27	1257	0.1759	3.659	1.12
	1343	0.143	2.98	1334	0.1639	3.409	1.14
	1419	0.152	3.17	1410	0.1563	3.251	1.03
Apr 19 90	817	0.211	4.39	807	0.1979	4.116	0.94
	853	0.201	4.19	843	0.2081	4.328	1.03
	926	0.217	4.52	917	0.2177	4.528	1.00
	1105	0.248	5.17	1054	0.2392	4.975	0.96
	1135	0.310	6.46	1126	0.3045	6.334	0.98
	1250	0.361	7.51	1240	0.3668	7.629	1.02
	1323	0.324	6.74	1314	0.3646	7.584	1.13
	1354	0.314	6.53	1345	0.39	8.112	1.24
	1432	0.308	6.41	1420	0.3085	6.417	1.00
Apr 20 90	826	0.277	5.76	813	0.2712	5.641	0.98
	856	0.268	5.57	847	0.2726	5.670	1.02
	930	0.270	5.61	921	0.2632	5.475	0.98
	1034	0.270	5.62	1025	0.2773	5.768	1.03
	1118	0.264	5.50	1109	0.2799	5.822	1.06
	1259	0.288	6.00	1250	0.2857	5.943	0.99
	1407	0.283	5.88	1358	0.2854	5.936	1.01
	1536	0.367	7.64	1527	0.316	6.573	0.86
Apr 23 90	1309	0.210	4.36	1112	0.2149	4.470	1.03
	1341	0.223	4.63	1300	0.2143	4.457	0.96
	1415	0.222	4.62	1332	0.2413	5.019	1.09
	1452	0.247	5.13	1406	0.2409	5.011	0.98
				1443	0.253	5.262	
Apr 24 90	823	0.316	6.58	812	0.324	6.739	1.02
	905	0.337	7.02	856	0.3294	6.852	0.98
	1025	0.324	6.74	1016	0.3184	6.623	0.98
	1058	0.334	6.95	1049	0.3272	6.806	0.98
	1131	0.347	7.21	1122	0.3596	7.480	1.04
	1306	0.373	7.77	1257	0.3532	7.347	0.95
	1343	0.382	7.95	1334	0.3802	7.908	0.99
	1422	0.394	8.20	1413	0.3792	7.887	0.96
				1523	0.3748	7.796	
Apr 25 90	815	0.437	9.10	805	0.4208	8.753	0.96
	849	0.419	8.71	840	0.4041	8.405	0.97
	925	0.436	9.07	915	0.4122	8.574	0.95
	1044	0.451	9.37	1035	0.4635	9.641	1.03
	1126	0.426	8.85	1117	0.4246	8.832	1.00
	1302	0.393	8.17	1253	0.4017	8.355	1.02
	1339	0.395	8.23	1330	0.3779	7.860	0.96
	1415	0.393	8.17	1406	0.4506	9.372	1.15
	1529	0.357	7.43	1521	0.3641	7.573	1.02
Apr 26 90	822	0.291	6.04	813	0.2697	5.610	0.93
	855	0.294	6.12	846	0.2905	6.042	0.99
	924	0.284	5.90	915	0.2896	6.024	1.02
	1041	0.282	5.86	1032	0.2896	6.024	1.03
	1127	0.275	5.72	1118	0.2944	6.124	1.07
	1310	0.256	5.32	1301	0.26	5.408	1.02
	1407	0.308	6.41	1358	0.2723	5.664	0.88
	1439	0.331	6.88	1427	0.2787	5.797	0.84
	1535	0.311	6.48	1526	0.3182	6.619	1.02
Apr 27 90	721	0.416	8.65	711	0.3628	7.546	0.87

Cont.

Table 9 - cont.

	752	0.398	8.27	743	0.4184	8.703	1.05
	826	0.406	8.45	817	0.3959	8.235	0.97
	856	0.436	9.08	847	0.3846	8.000	0.88
	931	0.567	11.79	921	0.4129	8.588	0.73
	1032	0.401	8.33	1022	0.3832	7.971	0.96
	1110	0.363	7.54	1101	0.3494	7.268	0.96
	1319	0.320	6.65	1310	0.32	6.656	1.00
	1416	0.315	6.55	1359	0.3245	6.750	1.03
Apr 30 90	828	0.304	6.32	819	0.3063	6.371	1.01
	901	0.309	6.42	851	0.3	6.240	0.97
	934	0.322	6.70	925	0.321	6.677	1.00
	1101	0.351	7.30	1051	0.313	6.510	0.89
	1135	0.328	6.83	1126	0.3321	6.908	1.01
	1255	0.314	6.53	1246	0.3005	6.250	0.96
	1326	0.313	6.51	1317	0.308	6.406	0.98
	1356	0.302	6.28	1347	0.32	6.656	1.06
	1428	0.373	7.75	1420	0.3335	6.937	0.90
May 01 90	749	0.122	2.54	740	0.1376	2.862	1.13
	826	0.139	2.89	817	0.1474	3.066	1.06
	856	0.136	2.82	848	0.1503	3.126	1.11
	928	0.132	2.75	918	0.1648	3.428	1.24
	1114	0.162	3.37	1105	0.1575	3.276	0.97
	1259	0.212	4.40	1250	0.201	4.181	0.95
	1410	0.199	4.14	1400	0.2072	4.310	1.04
	1537	0.194	4.03	1528	0.2121	4.412	1.10
May 02 90	811	0.182	3.79	759	0.1825	3.796	1.00
	852	0.193	4.01	842	0.1865	3.879	0.97
	929	0.209	4.35	920	0.2075	4.316	0.99
	1050	0.282	5.87	1041	0.1902	3.956	0.67
	1126	0.239	4.96	1117	0.209	4.347	0.88
	1305	0.259	5.38	1256	0.232	4.826	0.90
	1335	0.253	5.26	1326	0.238	4.950	0.94
	1410	0.263	5.46	1402	0.2291	4.765	0.87
May 03 90	809	0.242	5.03	800	0.2299	4.782	0.95
	910	0.213	4.44	901	0.2148	4.468	1.01
	939	0.228	4.74	930	0.228	4.742	1.00
	1038	0.259	5.38	1029	0.2377	4.944	0.92
	1109	0.227	4.71	1100	0.219	4.555	0.97
	1140	0.207	4.30	1131	0.212	4.410	1.03
	1316	0.221	4.59	1307	0.229	4.763	1.04
	1347	0.241	5.02	1338	0.2407	5.007	1.00
	1422	0.233	4.85	1413	0.2358	4.905	1.01
May 04 90	815	0.251	5.22	759	0.2439	5.073	0.97
	849	0.290	6.04	839	0.276	5.741	0.95
	920	0.287	5.98	911	0.2906	6.044	1.01
	1033	0.280	5.82	1024	0.2848	5.924	1.02
	1103	0.290	6.03	1054	0.28	5.824	0.97
	1339	0.322	6.69	1330	0.3203	6.662	1.00
	1424	0.317	6.60	1413	0.3182	6.619	1.00
				1534	0.2909	6.051	
May 07 90	829	0.169	3.51	820	0.1659	3.451	0.98
	932	0.038	0.80	923	0.0531	1.104	1.38
	1034	0.016	0.34	1024	0.0236	0.491	1.43
	1117	0.023	0.47	1108	0.0203	0.422	0.90
	1337	0.022	0.46	1324	0.0164	0.341	0.74
	1428	0.022	0.46	1418	0.0189	0.393	0.86

Cont.

Table 9 - cont.

May 08 90	829	0.019	0.40	820	0.0155	0.322	0.81
	1033	0.048	1.00	1054	0.0314	0.653	0.65
	1103	0.024	0.51	1255	0.0274	0.570	1.12
	1304	0.040	0.84	1329	0.0309	0.643	0.76
	1338	0.026	0.54	1359	0.0309	0.643	1.19
	1408	0.026	0.54	1428	0.0293	0.609	1.13
	1441	0.033	0.68	1524	0.0326	0.678	1.00
May 09 90	809	0.028	0.57	800	0.0231	0.480	0.84
	848	0.018	0.37	834	0.0235	0.489	1.33
	925	0.019	0.40	916	0.0247	0.514	1.30
	1042	0.034	0.70	1033	0.0228	0.474	0.68
	1126	0.020	0.41	1116	0.0276	0.574	1.40
	1254	0.022	0.46	1245	0.0269	0.560	1.21
	1324	0.021	0.43	1315	0.025	0.520	1.21
	1355	0.026	0.53	1346	0.0232	0.483	0.90
	1426	0.021	0.43	1417	0.0225	0.468	1.08
May 10 90	929	0.364	7.58	920	0.398	8.278	1.09
	1028	0.394	8.20	1019	0.4245	8.830	1.08
	1058	0.389	8.09	1049	0.447	9.298	1.15
	1128	0.414	8.60	1119	0.4486	9.331	1.08
	1309	0.242	5.03	1300	0.3457	7.191	1.43
	1339	0.073	1.52	1330	0.1141	2.373	1.56
	1410	0.041	0.85	1401	0.06	1.248	1.48
	1529	0.033	0.70	1520	0.0258	0.537	0.77
May 11 90	836	0.018	0.38	810	0.016	0.333	0.87
	906	0.020	0.42	857	0.0856	1.780	4.29
	936	0.021	0.43	928	0.0172	0.358	0.82
	1044	0.017	0.36	1035	0.0209	0.435	1.21
	1115	0.016	0.32	1106	0.0193	0.401	1.24
	1357	0.046	0.95	1348	0.0224	0.466	0.49
	1427	0.028	0.57	1418	0.022	0.458	0.80
May 16 90	750	0.217	4.51	740	0.1744	3.628	0.80
	827	0.199	4.15	817	0.1791	3.725	0.90
	914	0.173	3.6	905	0.184	3.827	1.06
	1019	0.174	3.63	932	0.1703	3.542	0.98
	1230	0.173	3.59	1026	0.1776	3.694	1.03
	1304	0.147	3.06	1221	0.1556	3.236	1.06
	1354	0.161	3.35	1244	0.1502	3.124	0.93
	1425	0.145	3.02	1309	0.1521	3.164	1.05
				1345	0.1529	3.180	
				1416	0.1527	3.176	
				1527	0.1451	3.018	
May 17 90	743	0.151	3.15	731	0.1273	2.648	0.84
	846	0.181	3.76	835	0.145	3.016	0.80
	1042	0.155	3.22	935	0.1488	3.095	0.96
	1122	0.171	3.55	1032	0.1463	3.043	0.86
	1304	0.158	3.29	1255	0.1372	2.854	0.87
	1419	0.158	3.29	1409	0.1259	2.619	0.80
May 18 90	724	0.096	1.99	714	0.0756	1.572	0.79
	1026	0.075	1.55	946	0.0783	1.629	1.05

Table 10 - ^{222}Rn progeny data by the Thomas-Tsivoglou method and as determined by the Pylon WL-1000C. Also shown are other environmental variables of interest.

Date	WL(Rn)	PAEC(Rn) (μJm^{-3})	WL(1000C)	PAEC(1000C) (μJm^{-3})	$\frac{PAEC(1000C)}{PAEC(Rn)}$	T (^{o}C)	RH (%)	N (cm^{-3})
Mar 19/90	0.046±0.005	0.96±0.11	0.046±0.01	0.96±0.13	1.00	21	40	100-400
Mar 20/90	0.052±0.00	1.09±0.08	0.054±0.01	1.13±0.20	1.04	21	38	100-300
Mar 21/90	0.059±0.005	1.22±0.11	0.073±0.00	1.52±0.11	1.24	21	51	100-390
Mar 22/90	0.11±0.01	2.39±0.26	0.11±0.01	2.32±0.26	0.97	21	57	120-280
Mar 23/90	0.053±0.01	1.11±0.22	0.067±0.011	1.39±0.22	1.25	21	49	90-350
Mar 26/90	0.048±0.01	1.00±0.16	0.051±0.00	1.05±0.11	1.05	21	46	180-450
Apr 3/90*	0.299±0.15	6.22±3.18	0.24±0.16	5.01±3.27	0.80	21	49	300-2.4x10^4
Apr 4/90	0.48±0.01	9.99±0.27	0.41±0.07	8.56±1.45	0.86	21	48	2.6x10^4
Apr 5/90	0.50±0.01	10.50±0.24	0.48±0.03	9.90±0.74	0.94	21	46	2.7x10^4
Apr 6/90	0.50±0.01	10.49±0.28	0.48±0.03	10.08±0.58	0.96	21	51	2.9x10^4
Apr 9/90*	1.14±0.28	23.8±5.82	1.05±0.37	21.75±7.76	0.91	21	54	60-2.8x10^4
Apr 10/90	1.25±0.03	26.06±0.54	1.18±0.05	24.62±1.03	0.94	21	54	2.9x10^4
Apr 11/90*	1.31±0.03	27.34±0.71	1.20±0.20	24.96±4.19	0.91	21	46	2.9x10^4
Apr 12/90	1.35±0.02	28.24±0.50	1.27±0.10	26.37±2.17	0.93	21	53	2.1x10^4-2.8x10^4
Apr 18/90	0.15±0.01	3.15±0.14	0.17±0.01	3.62±0.17	1.15	10.7	63	80-240
Apr 19/90	0.28±0.05	5.77±1.14	0.29±0.07	6.00±1.47	1.04	10.6	61	40-300
Apr 20/90	0.29±0.03	5.95±0.66	0.28±0.01	5.85±0.31	0.98	10.7	57	150-240
Apr 23/90	0.22±0.01	4.69±0.28	0.23±0.01	4.84±0.32	1.03	22-26	55	90-200
Apr 24/90	0.35±0.03	7.30±0.56	0.35±0.02	7.27±0.49	1.00	26	48	100-580
Apr 25/90	0.41±0.03	8.57±0.58	0.41±0.03	8.60±0.62	1.00	26	52	150-400
Apr 26/90	0.29±0.02	6.08±0.43	0.28±0.02	5.92±0.33	0.97	21-26	32-86	150-210
Apr 27/90	0.40±0.07	8.37±1.46	0.37±0.03	7.75±0.70	0.93	20	69-82	150-520

Cont.

Table 10 - Cont.

Date	WL(Rn)	PAEC(Rn) (μJm^{-3})	WL(1000C)	PAEC(1000C) (μJm^{-3})	$\frac{PAEC(1000C)}{PAEC(Rn)}$	T (^{o}C)	RH (%)	N (cm^{-3})
Apr 30/90	0.32±0.02	6.74±0.46	0.31±0.01	6.55±0.25	0.97	20	78	140-240
May 1/90	0.16±0.03	3.37±0.68	0.17±0.03	3.58±0.58	1.06	20	74-97	105-315
May 2/90	0.23±0.03	4.89±0.70	0.21±0.02	4.35±0.42	0.89	20	94-100	90-340
May 3/90	0.23±0.01	4.78±0.31	0.23±0.01	4.73±0.20	0.99	20	96-100	90-200
May 4/90	0.29±0.02	6.05±0.45	0.29±0.02	5.99±0.47	0.99	20	84-100	80-230
May 7/90*	0.048±0.054	1.007±1.129	0.050±0.053	1.03±1.11	1.02	21	22-68	100-400
May 8/90	0.031±0.01	0.64±0.19	0.028±0.005	0.59±0.11	0.92	21	21-36	40-690
May 9/90	0.023±0.004	0.478±0.100	0.024±0.002	0.507±0.036	1.06	21	22-41	70-310
May 10/90*	0.24±0.16	5.07±3.30	0.28±0.17	5.89±3.57	1.16	21	28-73	100-600
May 11/90	0.0236±0.01	0.49±0.20	0.029±0.023	0.60±0.48	1.22	22	14	70-190
May 16/90	0.17±0.02	3.61±0.48	0.16±0.01	3.39±0.28	0.94	21	45	70-375
May 17/90	0.16±0.01	3.38±0.21	0.14±0.01	2.88±0.19	0.85	21	52	90-420
May 18/90	-	-	0.08±0.00	1.60±0.03	-			

Notes: 1) T, RH, and N stand, respectively for temperature, relative humidity, and aerosol concentration. A single value indicates the daily average value. Two values indicate the range of values. However, if there is a large difference between those two values, the range is meant to indicate transient conditions between the indicated initial and final values.

2) WL(Rn) and PAEC(Rn) stand for the ^{222}Rn progeny Working Level and Potential Alpha Energy Concentration as determined by the Thomas-Tsivoglou method, respectively.

3) WL(1000C) and PAEC(1000C) stand for the values of the variables of item 2), but as determined by the Pylon WL-1000C.

4) It should be noted that WL(1000C)/WL(Rn) = PAEC(1000C)/PAEC(Rn).

5) Dates marked with an asterisk indicate tests conducted under transient conditions.

Table 11 - Data according to the MIMIL IIM.

			Mimil				
Date	Time	Bkgrd uJ/M3	c1	c2	c3	PAEC(M) uJ/M3	WL(M)
Mar 19 90	1132	0	62	24	39	1.047	0.050
	1323	0	58	27	37	0.99	0.048
Mar 20 90	820		68	43	44	1.18	0.057
	915	0.01	76	32		1.352	0.065
	1049	0	90	37	44	1.18	0.057
	1133		77	25		1.485	0.071
	1309	0	75	33	48	1.295	0.062
	1359	0	63	34	42	1.142	0.055
Mar 21 90	827	0	72	32		1.561	0.075
	911	0.05	78	35	40	1.085	0.052
	1421	0	85	29	57	1.542	0.074
	1535	0	86	37	65	1.752	0.084
Mar 22 90	835	0.01	111	58		2.78	0.134
	909		100	61	105	2.819	0.136
	940	0	103	61	92	2.457	0.118
	1050	0	97	70	104	2.78	0.134
	1125	0	108	64	102	2.742	0.132
	1304		119	70	108	2.895	0.139
	1404	0.6	99	60	81	2.171	0.104
	1540	0	116	65	84	2.247	0.108
Mar 23 90	820	0	82	26		1.047	0.050
	855	0.24	56	26	35	0.933	0.045
	928	0	53	30	36	0.971	0.047
	1035	0	82	37	47	1.276	0.061
	1238	0	77	38	54	1.447	0.070
	1316	1.75	40	5	0	0	0.000
	1350	0.28	76	35	37	0.99	0.048
	1438	0	82	45	54	1.447	0.070
Mar 26 90	822	0	57	22	37	0.99	0.048
	859	0	60	24	40	1.085	0.052
	934	0	75	27	34	0.914	0.044
	1039	0	70	36	43	1.161	0.056
	1115	0.01	69	28	32	0.857	0.041
	1307	0	67	40	35	0.952	0.046
	1341	0.03	57	39	44	1.18	0.057
	1422	0	70	31	32	0.876	0.042
Apr 03 90	822	0.01	74	36	40	1.066	0.051
	908	0	150	62	96	2.571	0.124
	940	0	227	122	203	5.428	0.261
	1055	0	327	201	371	9.904	0.476
	1131	0	317	213	389	10.38	0.499
	1358	0	300	212	390	10.4	0.500
	1431	0	347		388	10.36	0.498
Apr 04 90	830	0	399	271	450	12	0.577
	911	0	358	241	437	11.65	0.560
	1038	0	347	267	441	11.77	0.566
	1115	0.01	364	252	446	11.9	0.572
	1315	0	365	260	434	11.58	0.557
	1344	0	327	209	359	9.58	0.461
	1425	0	337	255	440	11.75	0.565

Cont.

Table 11 - cont.

	1539	0	340	251	423	11.29	0.543
Apr 05 90	821	0	394	286	486	12.97	0.624
	857	0.01	394	263	441	11.77	0.566
	935	0.05	359	305	495	13.2	0.635
	10.4	0	389	257	467	12.45	0.599
	1123	0.09	383	306	462	12.34	0.593
	1307	0	407	310	480	12.81	0.616
	1342	0	345	273	501	13.37	0.643
	1427	0.11	372	252	452	12.05	0.579
Apr 06 90	820	0	372	272	488	13.02	0.626
	855	0	411	280	461	12.3	0.591
	930	0	377	275	463	12.36	0.594
	1047	0	417	291	511	13.65	0.656
	1121	0	347	297	452	12.05	0.579
	1303	0	404	267	445	11.86	0.570
	1346	0	399	295	472	12.6	0.606
	1421	0	360	257	453	12.09	0.581
Apr 09 90	1135	0	620	355	581	15.5	0.745
	1306	0	958	695	1135	30.28	1.456
	1341	0	944	748	1217	32.47	1.561
	1424	0	1052	710	1224	32.64	1.569
Apr 10 90	929	0	953	670	1132	30.2	1.452
	1036	0	930	667	1149	30.64	1.473
	1110	0	908	599	1171	31.25	1.502
	1302	0	958	669	1179	31.46	1.513
	1341	0	939	666	1126	30.05	1.445
	1431	0.03	894	633	1119	29.86	1.436
	1539	0	917	662	1182	31.52	1.515
	1716	0	971	657	1166	31.12	1.496
	1750	112	0	0	0	0	0.000
	1800	2.6	861	642	1042	27.8	1.337
	1825	0.01	996	671	1182	31.52	1.515
	1857	0.03	937	630	1183	31.56	1.517
	1934	0	908	670	1162	30.99	1.490
	2006	0.01	921	596	1105	29.48	1.417
Apr 11 90	820	0.03	1031	704	1240	33.06	1.589
	854	0	1052	707	1250	33.35	1.603
	934	0.03	995	675	1211	32.32	1.554
	1040	0.01	1013	691	1204	32.11	1.544
	1114	0.01	1023	713	1228	32.76	1.575
	1305	0	1015	707	1205	32.15	1.546
	1338	0	962	738	1217	32.45	1.560
	1410	0.03	997	730	1148	30.64	1.473
	1443	0.01	1033	663	1143	30.49	1.466
Apr 12 90	816	0	1169	787	1322	35.25	1.695
	849	0	1076	762	1349	35.98	1.730
	928	0.03	1047	698	1268	33.84	1.627
	1047	0.11	1022	717	1235	32.95	1.584
	1120	0.01	1010	746	1229	32.78	1.576
Apr 18 90	800	0	206	92	145	3.872	0.186
	839	0	196	105	140	3.727	0.179
	913	1.98	155	50	72	1.927	0.093
	1041	0.12	208	101	129	3.436	0.165
	1113	0.08	185	97	150	4	0.192
	1143	0.07	192	106	144	3.836	0.184
	1312	0.01	208	95	129	3.454	0.166

Cont.

Table 11 - cont.

	1349	0.1	198	85	134	3.581	0.172
	1425	0.03	207	92	127	3.4	0.163
Apr 19 90	823	0.01	271	147	210	5.6	0.269
	859	0	235	145	194	5.181	0.249
	933	0	255	150	196	5.236	0.252
	1111	0.12	297	161	223	5.963	0.287
	1141	0	327	156	289	7.727	0.371
	1256	0	340	199	313	8.345	0.401
	1329	0.01	328	198	297	7.927	0.381
	1400	0	329	200	272	7.272	0.350
	1438	0	283	178	283	7.563	0.364
	1528	0	287	135	235	6.272	0.302
Apr 20 90	832	0	261	149	232	6.2	0.298
	902	0	267	152	248	6.36	0.306
	936	0	254	138	229	6.109	0.294
	1040	0	263	145	217	5.718	0.275
	1124	0	299	155	225	6.018	0.289
	1305	0.01	280	149	244	6.509	0.313
	1413	0	288	156	250	6.672	0.321
	1542	0.2	296	202	291	7.781	0.374
Apr 23 90	1315	0	270	141	200	5.345	0.257
	1347	0.05	243	114	220	5.872	0.282
	1421	0	248	136	197	5.524	0.266
	1501	0	280	147	233	6.218	0.299
Apr 24 90	829	0	314	178	302	8.054	0.387
	910	0	308	171	244	6.509	0.313
	1031	0.01	313	211	289	7.709	0.371
	1103	0.01	328	185	278	7.418	0.357
	1137	0	324	182	316	8.436	0.406
	1312	0	329	215	321	8.563	0.412
	1349	0	380	231	348	9.29	0.447
	1428	0	380	211	349	9.327	0.448
Apr 25 90	821	0.1	424		395	10.54	0.507
	855	0.05	392	236	369	9.854	0.474
	931	0	392	231	350	9.345	0.449
	1050	0	355	218	374	9.981	0.480
	1132	0	368	206	335	8.945	0.430
	1308	0.16	331	183	343	9.145	0.440
	1344	0	342	214	341	9.109	0.438
	1421	0	336	184	315	8.418	0.405
	1535	0.1	324	176	280	7.472	0.359
Apr 26 90	827	0	285	154	249	6.654	0.320
	900	0	304	176	263	7.036	0.338
	930	0.01	286	160	250	6.672	0.321
	1047	0	304	159	232	6.181	0.297
	1132	0	275	154	221	5.89	0.283
	1315	0.14	254	141	198	5.272	0.253
	1413	0	327	207	293	7.818	0.376
	1445	0.05	317	184	278	7.436	0.358
	1540	0	300	177	285	7.618	0.366
Apr 27 90	726	0.05	378	227	347	9.272	0.446
	757	0.01	359	229	345	9.218	0.443
	832	0	371	225	369	9.854	0.474
	902	0.05	424	234	390	10.4	0.500
	936	0	340	242	351	9.381	0.451
	1038	0.03	335	216	338	9.018	0.434

Cont.

Table 11 - cont.

	1115	0.09	305	177	291	7.763	0.373
	1325	0	334	175	260	6.927	0.333
	1421	0	285	171	271	7.218	0.347
Apr 30 90	833	0	274	157	285	7.6	0.365
	907	0	294	184	271	7.236	0.348
	939	0	316	185	295	7.872	0.378
	1106	0	285	166	264	7.054	0.339
	1140	0	308	182	282	7.527	0.362
	1300	0	308	174	281	7.509	0.361
	1332	0.01	332	168	251	6.709	0.323
	1401	0.03	315	156	272	7.272	0.350
	1433	0.03	299	167	239	6.381	0.307
May 01 90	754	0	164	90	133	3.563	0.171
	831	0	190	101	120	3.2	0.154
	902	0	197	95	117	3.109	0.149
	933	0	186	106	110	2.927	0.141
	1120	0.01	205	95	147	3.927	0.189
	1305	0.03	272	118	168	4.49	0.216
	1415	0.18	252	118	152	4.054	0.195
	1543	0	246	116	185	4.927	0.237
May 02 90	817	0	226	109	163	4.363	0.210
	858	0.03	226	113	176	4.69	0.225
	935	0.03	259	127	187	4.981	0.239
	1055	0	243	135	178	4.763	0.229
	1132	0	261	139	192	5.127	0.246
	1310	0.05	283	133	192	5.145	0.247
	1341	0	256	138	217	5.8	0.279
	1415	0.01	296	161	212	5.654	0.272
May 03 90	815	0	267	143	223	5.963	0.287
	916	0.09	239	142	176	4.69	0.225
	945	0	245	153	225	6.127	0.295
	1045	0.65	233	102	160	4.29	0.206
	1115	0	262	130	204	5.454	0.262
	1146	0	227	129	193	5.163	0.248
	1322	0	252	137	189	5.054	0.243
	1353	0.07	271	160	209	5.581	0.268
	1428	0	265	144	206	5.509	0.265
May 04 90	820	0.09	257	157	225	6	0.288
	855	0.16	303	176	253	6.745	0.324
	926	0.07	307	176	265	7.072	0.340
	1039	0.09	320	166	256	6.836	0.329
	1109	0.09	291	149	264	7.036	0.338
	1345	0	306	190	288	7.69	0.370
	1430	0	285	201	290	7.727	
May 07 90	835	0	205	96	136	3.636	0.175
	938	0	44	23	29	0.781	0.038
	1040	0	25	11	15	0.4	0.019
	1123	0	25	8	14	0.381	0.018
	1343	0	35	12	12	0.327	0.016
	1434	0	22	11	8	0.218	0.010
May 08 90	835	0	21	15	15	0.418	0.020
	1039	0.07	51		25	0.672	0.032
	1109	0	35	20	26	0.709	0.034
	1310	0.01	36	16	23	0.618	0.030
	1343	0	47	19	34	0.909	0.044
	1414	0	41	17	18	0.49	0.024

Cont.

Table 11 - cont.

	1447	0	50	18	26	0.69	0.033	
May 09 90	815	0	39	17	22	0.581	0.028	
	855	0	34	7	15	0.418	0.020	
	931	0.07	26	13	12	0.309	0.015	
	1048	0	45	19	23	0.618	0.030	
	1131	0	34	13	17	0.472	0.023	
	1300	0.01	39	14	18	0.472	0.023	
	1330	0.45	25	3	6	0.163	0.008	
	1400	0	38	19	15	0.4	0.019	
	1431	0	31	14	21	0.563	0.027	
May 10 90	934	0	415	222	322	8.6	0.413	
	1034	0.01	425	236	370	9.872	0.475	
	1104	0	427	236	345	9.218	0.443	
	1134	2.98	374	195	283	7.563	0.364	
	1315	0.18	231	122	191	5.109	0.246	
	1345	0	83	47	62	1.672	0.080	
	1535	0	27	18	17	0.472	0.023	
May 11 90	841	0	25	13	15	0.4	0.019	
	912	0	23	13	12	0.327	0.016	
	942	0	33	9	11	0.309	0.015	
	1050	0	27	10	15	0.4	0.019	
	1121	0	32	9	11	0.309	0.015	
	1402	0	45	19	16	0.418	0.020	
	1433	0	41	15	13	0.345	0.017	
May 14 90								
	Bkgrds meas. using blank filters			Outside the RTTF				
	830	0	0	0	0	0	0.000	
	904	0	0	0	1	0.018	0.001	
	930	0.07	0	0	0	0	0.000	
	950	0	0	0	0	0	0.000	
	1025	0	0	2	0	0	0.000	
	1106	0.01	0	0	0	0.018	0.001	
	1128	0	0	0	0	0	0.000	
	1250	0	0	0	0	0	0.000	
	1315	0	0	0	0	0	0.000	
May 14 90								
	Bkgrds meas. using blank filters			Inside the RTTF				
	1345	0.12	3	0	0	0.018	0.001	
	1413	0.09	7	0	4	0.109	0.005	
	1438	0.1	5	0	0	0	0.000	
	1527	0.05	35	9	9	0.236	0.011	Note 1527 used same filter as 1438
May 15 90								
	Bkgrds meas. using blank filters			Inside the RTTF				Note instruments left in rttf overnight
	747	0.16	1	3	0	0.018	0.001	
	823	0.12	9	1	6	0.163	0.008	
	848	0.01	15	6	10	0.272	0.013	
	915	0.05	12	13	20	0.545	0.026	
	941	0.05	7	1	5	0.127	0.006	
	1049	0.03	6	3	10	0.272	0.013	
	1120	0.14	0	0	0	0	0.000	
	1145	0.03	41	20	18	0.49	0.024	
May 15 90								Gamma field
	Bkgrds meas. using blank filters			Outside the RTTF				mR/hr
	1340	0	0	2	0	0	0.000	bkgrd
	1404	0.12	2	0	0	0	0.000	13.5
	1430	0	0	0	1	0.036	0.002	13.5

Cont.

Table 11 - cont.

	1453	0	0	0	0	0	0.000	bkgrd
	1530	0.01	0	0	0	0	0.000	bkgrd
May 16 90								
Normal sampling from the RTTF				measurements carried out with and without gamma field				
								Gamma field mR/hr
	756	0	216	119	168	4.49	0.216	bkgrd
	834	0.01	226	116	137	3.654	0.176	13.5
	919	0	235	120	154	4.127	0.198	bkgrd
	943	0	188	98	145	3.872	0.186	2.5
	1035	0.03	188	109	135	3.6	0.173	2.5
	1236	0	210	98	145	3.872	0.186	bkgrd
	1254	2.21	141	46	51	1.381	0.066	2.5
	1325	0	210	108	154	4.127	0.198	bkgrd
	1401	0.01	191	107	130	3.781	0.182	2.5
	1431	0	203	92	144	3.854	0.185	bkgrd
	1537	0	182	90	130	3.472	0.167	bkgrd
May 17 90								
Normal sampling from the RTTF								
	748	0	212	100	114	3.054	0.147	
	853	1.6	174	56	68	1.836	0.088	
	944	0.01	190	90	122	3.272	0.157	
	1047	0.05	205	97	137	3.672	0.177	
	1110	0	184	98	132	3.509	0.169	
	1425	0	182	85	136	3.636	0.175	
May 18 90	731	0.05	168	61	65	1.745	0.084	
	1032	0	145	59	71	1.909	0.092	
Jun 01 90								
	928	0.01	172	103	218	5.818	0.280	
	945	0.01	200	123	226	6.036	0.290	
	1011	0.05	161	95	195	5.218	0.251	
	1033	0.01	160	104	209	5.581	0.268	
	1051	0.01	176	104	193	5.163	0.248	
Jun 11 90	1037	0.01	271	176	300	8	0.385	
	1206	0.07	174	119	207	5.545	0.267	
	1233	0.05	103	61	109	2.909	0.140	

Table 12 - Data by the Thomas-Tsivoglou method and according to the MIMIL IIM

	Thomas			Mimil			
Date	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	Time	WL(M)	PAEC(M) (uJ/m3)	PAEC(M) / PAEC(Rn)
Mar 19 90	1120	0.041	0.85	1132	0.050	1.047	1.24
	1315	0.052	1.07	1325	0.048	0.99	0.92
Mar 20 90	813	0.056	1.18	820	0.057	1.18	1.00
	909	0.051	1.06	915	0.065	1.352	1.28
	1037	0.054	1.13	1049	0.057	1.18	1.04
	1125	0.046	0.96	1133	0.071	1.485	1.55
	1303	0.057	1.19	1309	0.062	1.295	1.08
	1347	0.050	1.05	1359	0.055	1.142	1.09
Mar 21 90	819	0.052	1.08	827	0.075	1.561	1.44
	904	0.057	1.18	911	0.052	1.085	0.92
	1415	0.060	1.25	1421	0.074	1.542	1.23
	1528	0.067	1.38	1535	0.084	1.752	1.27
Mar 22 90	828	0.104	2.16	835	0.134	2.78	1.29
	902	0.104	2.17	909	0.136	2.819	1.30
	934	0.096	2.00	940	0.118	2.457	1.23
	1121	0.118	2.45	1050	0.134	2.78	1.14
	1257	0.114	2.38	1125	0.132	2.742	1.15
	1358	0.125	2.59	1304	0.139	2.895	1.12
	1433	0.124	2.59	1404	0.104	2.171	0.84
	1533	0.136	2.83	1540	0.108	2.247	0.79
Mar 23 90	812	0.043	0.88	820	0.050	1.047	1.18
	849	0.040	0.83	855	0.045	0.933	1.12
	922	0.050	1.03	928	0.047	0.971	0.94
	1029	0.043	0.89	1035	0.061	1.276	1.44
	1232	0.061	1.27	1238	0.070	1.447	1.14
	1310	0.055	1.15	1316	0.000	0	0.00
	1344	0.070	1.45	1350	0.048	0.99	0.68
	1431	0.065	1.35	1438	0.070	1.447	1.07
Mar 26 90	816	0.055	1.15	822	0.048	0.99	0.86
	853	0.039	0.81	859	0.052	1.085	1.35
	928	0.037	0.76	934	0.044	0.914	1.20
	1033	0.039	0.81	1039	0.056	1.161	1.43
	1109	0.052	1.08	1115	0.041	0.857	0.79
	1301	0.052	1.09	1307	0.046	0.952	0.88
	1335	0.056	1.16	1341	0.057	1.18	1.02
	1416	0.055	1.14	1422	0.042	0.876	0.77
Apr 03 90	815	0.060	1.24	822	0.051	1.066	0.86
	902	0.102	2.11	908	0.124	2.571	1.22
	934	0.238	4.96	940	0.261	5.428	1.09
	1049	0.391	8.14	1055	0.476	9.904	1.22
	1125	0.415	8.63	1131	0.499	10.38	1.20
	1349	0.451	9.38	1358	0.500	10.4	1.11
	1424	0.437	9.08	1431	0.498	10.36	1.14
Apr 04 90	824	0.494	10.28	830	0.577	12	1.17
	905	0.505	10.51	911	0.560	11.65	1.11
	1032	0.471	9.79	1038	0.566	11.77	1.20
	1109	0.466	9.68	1115	0.572	11.9	1.23
	1309	0.485	10.08	1315	0.557	11.58	1.15
	1338	0.470	9.77	1344	0.461	9.58	0.98
	1419	0.478	9.93	1425	0.565	11.75	1.18

Cont.

Table 12 - cont.

	1533	0.473	9.84	1539	0.543	11.29	1.15
Apr 05 90	815	0.517	10.76	821	0.624	12.97	1.21
	851	0.524	10.90	857	0.566	11.77	1.08
	929	0.504	10.48	935	0.635	13.2	1.26
	1035	0.492	10.23	1040	0.599	12.45	1.22
	1117	0.512	10.66	1123	0.593	12.34	1.16
	1301	0.499	10.39	1307	0.616	12.81	1.23
	1339	0.490	10.20	1342	0.643	13.37	1.31
	1421	0.498	10.36	1427	0.579	12.05	1.16
Apr 06 90	814	0.520	10.83	820	0.626	13.02	1.20
	849	0.509	10.59	855	0.591	12.3	1.16
	924	0.484	10.06	930	0.594	12.36	1.23
	1041	0.510	10.61	1047	0.656	13.65	1.29
	1115	0.502	10.45	1121	0.579	12.05	1.15
	1257	0.512	10.64	1303	0.570	11.86	1.11
	1340	0.515	10.72	1346	0.606	12.6	1.18
	1415	0.482	10.02	1421	0.581	12.09	1.21
Apr 09 90	1129	0.662	13.78	1135	0.745	15.5	1.12
	1300	1.248	25.96	1306	1.456	30.28	1.17
	1335	1.306	27.16	1341	1.561	32.47	1.20
	1417	1.357	28.22	1424	1.569	32.64	1.16
Apr 10 90	923	1.261	26.23	929	1.452	30.2	1.15
	1030	1.269	26.40	1036	1.473	30.64	1.16
	1104	1.200	24.95	1110	1.502	31.25	1.25
	1256	1.304	27.12	1302	1.513	31.46	1.16
	1335	1.246	25.92	1341	1.445	30.05	1.16
	1426	1.230	25.58	1431	1.436	29.86	1.17
	1525	1.219	25.36	1539	1.515	31.52	1.24
	1710	1.259	26.19	1716	1.496	31.12	1.19
	1744	1.250	25.99	1750	0.000	0	0.00
	1819	1.252	26.03	1800	1.337	27.8	1.07
	1852	1.290	26.84	1825	1.515	31.52	1.17
	1928	1.251	26.03	1857	1.517	31.56	1.21
	2000	1.258	26.16	1934	1.490	30.99	1.18
				2006	1.417	29.48	ERR
Apr 11 90	814	1.277	26.55	820	1.589	33.06	1.25
	848	1.290	26.82	854	1.603	33.35	1.24
	928	1.267	26.35	934	1.554	32.32	1.23
	1035	1.375	28.61	1040	1.544	32.11	1.12
	1108	1.341	27.90	1114	1.575	32.76	1.17
	1259	1.328	27.62	1305	1.546	32.15	1.16
	1322	1.288	26.79	1338	1.560	32.45	1.21
	1404	1.340	27.88	1410	1.473	30.64	1.10
	1437	1.326	27.57	1443	1.466	30.49	1.11
Apr 12 90	810	1.376	28.63	816	1.695	35.25	1.23
	843	1.363	28.35	849	1.730	35.98	1.27
	922	1.376	28.62	928	1.627	33.84	1.18
	1041	1.362	28.33	1047	1.584	32.95	1.16
	1114	1.311	27.27	1120	1.576	32.78	1.20
Apr 18 90	754	0.153	3.19	800	0.186	3.872	1.21
	832	0.153	3.19	839	0.179	3.727	1.17
	907	0.151	3.14	913	0.093	1.927	0.61
	937	0.163	3.40	1041	0.165	3.436	1.01
	1035	0.153	3.17	1113	0.192	4	1.26
	1107	0.153	3.19	1143	0.184	3.836	1.20
	1137	0.136	2.84	1312	0.166	3.454	1.22

Cont.

Table 12 - cont.

	1306	0.157	3.27	1349	0.172	3.581	1.10
	1343	0.143	2.98	1425	0.163	3.4	1.14
	1419	0.152	3.17				
Apr 19 90	817	0.211	4.39	823	0.269	5.6	1.28
	853	0.201	4.19	859	0.249	5.181	1.24
	926	0.217	4.52	933	0.252	5.236	1.16
	1105	0.248	5.17	1111	0.287	5.963	1.15
	1135	0.310	6.46	1141	0.371	7.727	1.20
	1250	0.361	7.51	1256	0.401	8.345	1.11
	1323	0.324	6.74	1329	0.381	7.927	1.18
	1354	0.314	6.53	1400	0.350	7.272	1.11
	1432	0.308	6.41	1438	0.364	7.563	1.18
				1528	0.302	6.272	
Apr 20 90	826	0.277	5.76	832	0.298	6.2	1.08
	856	0.268	5.57	902	0.306	6.36	1.14
	930	0.270	5.61	936	0.294	6.109	1.09
	1034	0.270	5.62	1040	0.275	5.718	1.02
	1118	0.264	5.50	1124	0.289	6.018	1.09
	1259	0.288	6.00	1305	0.313	6.509	1.09
	1407	0.283	5.88	1413	0.321	6.672	1.14
	1536	0.367	7.64	1542	0.374	7.781	1.02
Apr 23 90	1309	0.210	4.36	1315	0.257	5.345	1.23
	1341	0.223	4.63	1347	0.282	5.872	1.27
	1415	0.222	4.62	1421	0.266	5.524	1.20
	1452	0.247	5.13	1501	0.299	6.218	1.21
Apr 24 90	823	0.316	6.58	829	0.387	8.054	1.22
	905	0.337	7.02	910	0.313	6.509	0.93
	1025	0.324	6.74	1031	0.371	7.709	1.14
	1058	0.334	6.95	1103	0.357	7.418	1.07
	1131	0.347	7.21	1137	0.406	8.436	1.17
	1306	0.373	7.77	1312	0.412	8.563	1.10
	1343	0.382	7.95	1349	0.447	9.29	1.17
	1422	0.394	8.20	1428	0.448	9.327	1.14
Apr 25 90	815	0.437	9.10	821	0.507	10.54	1.16
	849	0.419	8.71	855	0.474	9.854	1.13
	925	0.436	9.07	931	0.449	9.345	1.03
	1044	0.451	9.37	1050	0.480	9.981	1.06
	1126	0.426	8.85	1132	0.430	8.945	1.01
	1302	0.393	8.17	1308	0.440	9.145	1.12
	1339	0.395	8.23	1344	0.438	9.109	1.11
	1415	0.393	8.17	1421	0.405	8.418	1.03
	1529	0.357	7.43	1535	0.359	7.472	1.01
Apr 26 90	822	0.291	6.04	827	0.320	6.654	1.10
	855	0.294	6.12	900	0.338	7.036	1.15
	924	0.284	5.90	930	0.321	6.672	1.13
	1041	0.282	5.86	1047	0.297	6.181	1.06
	1127	0.275	5.72	1132	0.283	5.89	1.03
	1310	0.256	5.32	1315	0.253	5.272	0.99
	1407	0.308	6.41	1413	0.376	7.818	1.22
	1439	0.331	6.88	1445	0.358	7.436	1.08
	1535	0.311	6.48	1540	0.366	7.618	1.18
Apr 27 90	721	0.416	8.65	726	0.446	9.272	1.07
	752	0.398	8.27	757	0.443	9.218	1.11
	826	0.406	8.45	832	0.474	9.854	1.17
	856	0.436	9.08	902	0.500	10.4	1.15
	931	0.567	11.79	936	0.451	9.381	0.80

Cont.

Table 12 - cont.

	1032	0.401	8.33	1038	0.434	9.018	1.08
	1110	0.363	7.54	1115	0.373	7.763	1.03
	1319	0.320	6.65	1325	0.333	6.927	1.04
	1416	0.315	6.55	1421	0.347	7.218	1.10
Apr 30 90	828	0.304	6.32	833	0.365	7.6	1.20
	901	0.309	6.42	907	0.348	7.236	1.13
	934	0.322	6.70	939	0.378	7.872	1.18
	1101	0.351	7.30	1106	0.339	7.054	0.97
	1135	0.328	6.83	1140	0.362	7.527	1.10
	1255	0.314	6.53	1300	0.361	7.509	1.15
	1326	0.313	6.51	1332	0.323	6.709	1.03
	1356	0.302	6.28	1401	0.350	7.272	1.16
	1428	0.373	7.75	1433	0.307	6.381	0.82
May 01 90	749	0.122	2.54	754	0.171	3.563	1.40
	826	0.139	2.89	831	0.154	3.2	1.11
	856	0.136	2.82	902	0.149	3.109	1.10
	928	0.132	2.75	933	0.141	2.927	1.06
	1114	0.162	3.37	1120	0.189	3.927	1.17
	1259	0.212	4.40	1305	0.216	4.49	1.02
	1410	0.199	4.14	1415	0.195	4.054	0.98
	1537	0.194	4.03	1543	0.237	4.927	1.22
May 02 90	811	0.182	3.79	817	0.210	4.363	1.15
	852	0.193	4.01	858	0.225	4.69	1.17
	929	0.209	4.35	935	0.239	4.981	1.15
	1050	0.282	5.87	1055	0.229	4.763	0.81
	1126	0.239	4.96	1132	0.246	5.127	1.03
	1305	0.259	5.38	1310	0.247	5.145	0.96
	1335	0.253	5.26	1341	0.279	5.8	1.10
	1410	0.263	5.46	1415	0.272	5.654	1.04
May 03 90	809	0.242	5.03	815	0.287	5.963	1.18
	910	0.213	4.44	916	0.225	4.69	1.06
	939	0.228	4.74	945	0.295	6.127	1.29
	1038	0.259	5.38	1045	0.206	4.29	0.80
	1109	0.227	4.71	1115	0.262	5.454	1.16
	1140	0.207	4.30	1146	0.248	5.163	1.20
	1316	0.221	4.59	1322	0.243	5.054	1.10
	1347	0.241	5.02	1353	0.268	5.581	1.11
	1422	0.233	4.85	1428	0.265	5.509	1.14
May 04 90	815	0.251	5.22	820	0.288	6	1.15
	849	0.290	6.04	855	0.324	6.745	1.12
	920	0.287	5.98	926	0.340	7.072	1.18
	1033	0.280	5.82	1039	0.329	6.836	1.17
	1103	0.290	6.03	1109	0.338	7.036	1.17
	1339	0.322	6.69	1345	0.370	7.69	1.15
	1424	0.317	6.60	1430		7.727	0.00
May 07 90	829	0.169	3.51	835	0.175	3.636	1.04
	932	0.038	0.80	938	0.038	0.781	0.98
	1034	0.016	0.34	1040	0.019	0.4	1.17
	1117	0.023	0.47	1123	0.018	0.381	0.81
	1337	0.022	0.46	1343	0.016	0.327	0.71
	1428	0.022	0.46	1434	0.010	0.218	0.48
May 08 90	829	0.019	0.40	835	0.020	0.418	1.06
	1033	0.048	1.00	1039	0.032	0.672	0.67
	1103	0.024	0.51	1109	0.034	0.709	1.40
	1304	0.040	0.84	1310	0.030	0.618	0.73
	1338	0.026	0.54	1343	0.044	0.909	1.68

Cont.

Table 12 - cont.

	1408	0.026	0.54	1414	0.024	0.49	0.91
	1441	0.033	0.68	1447	0.033	0.69	1.02
May 09 90	809	0.028	0.57	815	0.028	0.581	1.01
	848	0.018	0.37	855	0.020	0.418	1.14
	925	0.019	0.40	931	0.015	0.309	0.78
	1042	0.034	0.70	1048	0.030	0.618	0.88
	1126	0.020	0.41	1131	0.023	0.472	1.15
	1254	0.022	0.46	1300	0.023	0.472	1.02
	1324	0.021	0.43	1330	0.008	0.163	0.38
	1355	0.026	0.53	1400	0.019	0.4	0.75
	1426	0.021	0.43	1431	0.027	0.563	1.30
May 10 90	929	0.364	7.58	934	0.413	8.6	1.13
	1028	0.394	8.20	1034	0.475	9.872	1.20
	1058	0.389	8.09	1104	0.443	9.218	1.14
	1128	0.414	8.60	1134	0.364	7.563	0.88
	1309	0.242	5.03	1315	0.246	5.109	1.02
	1339	0.073	1.52	1345	0.080	1.672	1.10
	1410	0.041	0.85	1535	0.023	0.472	0.56
	1529	0.033	0.70				
May 11 90	836	0.018	0.38	841	0.019	0.4	1.05
	906	0.020	0.42	912	0.016	0.327	0.79
	936	0.021	0.43	942	0.015	0.309	0.71
	1044	0.017	0.36	1050	0.019	0.4	1.11
	1115	0.016	0.32	1121	0.015	0.309	0.95
	1357	0.046	0.95	1402	0.020	0.418	0.44
	1427	0.028	0.57	1433	0.017	0.345	0.60
May 16 90	750	0.217	4.51	756	0.216	4.49	1.00
	827	0.199	4.15	834	0.176	3.654	0.88
	914	0.173	3.60	919	0.198	4.127	1.15
	1019	0.174	3.63	943	0.186	3.872	1.07
	1230	0.173	3.59	1035	0.173	3.6	1.00
	1304	0.147	3.06	1236	0.186	3.872	1.26
	1354	0.161	3.35	1254	0.066	1.381	0.41
	1425	0.145	3.02	1325	0.198	4.127	1.36
				1401	0.182	3.781	
				1431	0.185	3.854	
				1537	0.167	3.472	
May 17 90	743	0.151	3.15	748	0.147	3.054	0.97
	846	0.181	3.76	853	0.088	1.836	0.49
	1042	0.155	3.22	944	0.157	3.272	1.02
	1122	0.171	3.55	1047	0.177	3.672	1.03
	1304	0.158	3.29	1110	0.169	3.509	1.07
	1419	0.158	3.29	1425	0.175	3.636	1.11
May 18 90	724	0.096	1.99	731	0.084	1.745	0.88
	1026	0.075	1.55	1032	0.092	1.909	1.23

Table 13 - ^{222}Rn progeny data by the Thomas-Tsivoglou method and as determined by the MIMIL IIM. Also shown are other environmental variables of interest.

Date	PAEC(Rn) (μJm^{-3})	WL(Rn)	PAEC(M). (μJm^{-3})	WL(M).	$\frac{PAEC(M).}{PAEC(Rn)}$	T. (^{o}C)	RH. (%)	N (cm^{-3})
Mar 19/90	0.96±0.11	0.046±0.005	1.02±0.03	0.049±0.001	1.06	21	40	100-400
Mar 20/90	1.09±0.08	0.052±0.00	1.27±0.12	0.061±0.006	1.16	21	38	100-300
Mar 21/90	1.22±0.11	0.059±0.005	1.48±0.24	0.07±0.01	1.21	21	51	100-390
Mar 22/90	2.39±0.26	0.11±0.01	2.61±0.26	0.12±0.01	1.09	21	57	120-280
Mar 23/90	1.11±0.22	0.053±0.01	1.01±0.43	0.049±0.02	0.91	21	49	90-350
Mar 26/90	1.00±0.16	0.048±0.01	1.00±0.12	0.048±0.006	1.00	21	46	180-450
Apr 3/90*	6.22±3.18	0.299±0.15	7.16±3.77	0.34±0.18	1.15	21	49	300-2.4x10^{4}
Apr 4/90	9.99±0.27	0.48±0.01	11.44±0.73	0.55±0.03	1.14	21	48	2.6x10^{4}
Apr 5/90	10.50±0.24	0.50±0.01	12.62±0.52	0.61±0.02	1.20	21	46	2.7x10^{4}
Apr 6/90	10.49±0.28	0.50±0.01	12.49±0.55	0.60±0.03	1.19	21	51	2.9x10^{4}
Apr 9/90*	23.80±5.82	1.14±0.28	27.72±7.12	1.33±0.34	1.16	21	54	60-2.8x10^{4}
Apr 10/90	26.06±0.54	1.25±0.03	28.39±7.94	1.36±0.38	1.09	21	54	2.9x10^{4}
Apr 11/90*	27.34±0.71	1.31±0.03	32.15±0.93	1.54±0.04	1.18	21	46	2.9x10^{4}
Apr 12/90	28.24±0.50	1.35±0.02	34.16±1.26	1.64±0.06	1.21	21	53	2.1x10^{4}-2.8x10^{4}
Apr 18/90	3.15±0.14	0.15±0.01	3.47±0.58	0.17±0.03	1.10	10.7	63	90-240
Apr 19/90	5.77±1.14	0.28±0.05	6.71±1.13	0.32±0.05	1.16	10.6	61	40-300
Apr 20/90	5.95±0.66	0.29±0.03	6.42±0.58	0.31±0.028	1.08	10.7	57	150-240
Apr 23/90	4.69±0.28	0.22±0.01	5.74±0.33	0.27±0.02	1.22	22-26	55	90-200
Apr 24/90	7.30±0.56	0.35±0.03	8.16±0.89	0.39±0.04	1.12	26	48	100-580
Apr 25/90	8.57±0.58	0.41±0.03	9.20±0.85	0.44±0.04	1.07	26	52	150-400
Apr 26/90	6.08±0.43	0.29±0.02	6.73±0.80	0.32±0.04	1.11	21-26	32-86	150-210
Apr 27/90	8.37±1.46	0.40±0.07	8.78±1.13	0.42±0.05	1.05	20	69-82	150-520

Cont.

Table 13 - Cont.

Date	PAEC(Rn) (μJm^{-3})	WL(Rn)	PAEC(M). (μJm^{-3})	WL(M).	PAEC(M). / PAEC(Rn)	T. (^oC)	RH. (%)	N (cm^{-3})
Apr 30/90	6.74±0.46	0.32±0.02	7.24±0.44	0.35±0.02	1.07	20	78	140-240
May 1/90	3.37±0.68	0.16±0.03	3.77±0.66	0.18±0.03	1.12	20	74-97	105-315
May 2/90	4.89±0.70	0.23±0.03	5.06±0.45	0.24±0.02	1.03	20	94-100	90-340
May 3/90	4.78±0.31	0.23±0.01	5.31±0.55	0.25±0.03	1.11	20	96-100	90-200
May 4/90	6.05±0.45	0.29±0.02	7.01±0.55	0.33±0.03	1.16	20	84-100	80-230
May 7/90*	1.007±1.129	0.048±0.054	0.96±1.21	0.046±0.058	0.95	21	22-68	100-400
May 8/90	0.64±0.19	0.031±0.01	0.64±0.15	0.031±0.01	1.00	21	21-36	40-690
May 9/90	0.478±0.100	0.023±0.004	0.444±0.135	0.021±0.006	0.93	21	22-41	70-310
May 10/90*	5.07±3.30	0.24±0.16	6.07±3.47	0.29±0.17	1.20	21	28-73	100-600
May 11/90	0.49±0.20	0.024±0.01	0.36±0.04	0.017±0.002	0.73	22	14	70-190
May 16/90	3.61±0.48	0.17±0.02	3.66±0.77	0.176±0.037	1.01	21	45	70-375
May 17/90	3.38±0.21	0.16±0.01	3.16±0.63	0.15±0.03	0.93	21	52	90-420
May 18/90	1.77±0.22	0.085±0.01	1.83±0.08	0.09±0.00	1.03	21	44-47	~300

Notes: 1) T, RH, and N stand, respectively for temperature, relative humidity, and aerosol concentration. A single value indicates the daily average value. Two values indicate the range of values. However, if there is a large difference between those two values, the range is meant to indicate transient conditions between the indicated initial and final values.

2) WL(Rn) and PAEC(Rn) stand, respectively, for the ^{222}Rn progeny Working Level and Potential Alpha Energy Concentration as determined by the Thomas-Tsivoglou method.

3) WL(M) and PAEC(M) stand for the values of the variables of item 2), but as determined by the MIMIL IIM.

4) Dates marked with an asterisk indicate tests conducted under transient conditions.

5) It should be noted that WL(M)/WL(Rn) - PAEC(M)/PAEC(Rn).

Table 14 - Values for the ratio PAEC(X)/PAEC(Rn), where X refers to the particular instrument tested, and calculated values for P (defined below) for the instrumentation under evaluation.

PAEC(1)/PAEC(Rn)	P(1) (%)	PAEC(2)/PAEC(Rn)	P(2) (%)	PAEC(30)/PAEC(Rn)	P(30) (%)	PAEC(1000C)/PAEC(Rn)	P(1000C) (%)	PAEC(M)/PAEC(Rn)	P(M) (%)	T (^oC)	RH (%)	N (cm^{-3})
1.11±0.21	18.9	1.19±0.25	21.0	0.94±0.16	17.0	0.999±0.106	10.6	1.08±0.11	10.2	10.6-26	14-100	40-3.0x10^4

Notes: 1) PAEC stands for Potential Alpha Energy Concentration (PAEC - 20.8 WL, where WL stands for Working Level).

2) The symbols in round brackets after PAEC stand for ^{222}Rn progeny as determined by: the Thomas-Tsivoglou method (Rn), the MIMIL IIM (M), the EDA WLM-30 (30), the Pylon WL-1000C (1000C), and the first and second reading by the MDA IWLM-811, i.e., (1) and (2), respectively.

3) As previously indicated the ratio PAEC(X)/PAEC(Y) is equivalent to the ratio WL(X)/WL(Y).

4) The above ratios represent 'overall' averages of all the daily averages obtained for these ratios for each instrument during the entire experimental evaluation period.

5) The values for temperature (T), relative humidity (RH), and aerosol concentration (N) represent the entire range of values for these variables, i.e., from the minimum value to the maximum value attained during the tests. These ranges of values are given for each variable independently from the values for the other two variables.

6) The symbol P stands for the ratio SD/F, where SD stands for the standard deviation, and F is the ratio PAEC(X)/PAEC(Rn) (X is used to indicate (1), (2), (30), (1000C) and (M), i.e., the values given for the PAEC for the different instruments tested.) For example, P(1) - (0.21/1.11) x 10^2, and so on.

Table 15 - Instrument ranking according to some attributes.

Instrument	Simplicity of Operation	Data Access.	Resistance to Environ.	Flexibility	Ruggedness	Portability	Total Score
MDA IWLM-811	1	1[a]	2	0[d]	2	2	[illegible]
Pylon WL-1000C	1	1[b]	2	2	2	1	9
EDA WLM-30	0[+]	0	0[c]	0[d]	2	1	3
MIMIL IIM	2	2	2	0[d]	2	2	10

Notes: [+] Because it requires a computer to program the instrument and to retrieve the data.

[a] It requires adding the readings of two channels, i.e., the α- and β-channel.

[b] Final data is not readily displayed automatically.

[c] After extended operation the filter clogs because of aerosol or dust loading and airflow through the filter stops. However, this should not be held against the instrument because it is the only one of the four operating on a continuous basis.

[d] Only a radioactive measurement available.

Table 16 - Measurements by the Thomas-Tsivoglou and Kusnetz methods taken underground.

Quirke II u/g

Grab samples (Thomas-Tsivoglou & Kusnetz)

Date	Time	[218Po]		[214Pb]		[214Bi]		WL(Rn)	PAEC(Rn)	[214Pb]/[218Po]	[214Bi]/[218Po]	
		pCi/L	Bq/m3	pCi/L	Bq/m3	pCi/L	Bq/m3		(uJ/m3)			
Jun 01 90	Drift 11041, west of 11850											
	918							0.221	4.597			
	935							0.220	4.576			
	956							0.222	4.618			
	1022	29.107	1076.942	20.019	740.707	14.930	552.426	0.187	3.896	0.688	0.513	
	1041							0.214	4.451			
							Av.:	0.213	4.428			
							SD :	0.013	0.272			
Jun 11 90	Drift 11041, west of 11850											
	1046							0.346	7.197			
	1205	38.617	1428.847	23.930	885.416	15.137	560.080	0.218	4.529	0.620	0.392	
	1241							0.280				
							Av.:	0.281	5.863			
							SD :	0.052	1.334			
Jun 12 90	Stope 11680											
	1146	47.803	1768.721	20.043	741.580	10.236	378.725	0.189	3.934	0.419	0.214	
	1210							0.212	4.410			
	1224	48.952	1811.242	17.467	646.272	7.949	294.118	0.169	3.509	0.357	0.162	
	1258							0.193	4.014			
							Av.:	0.191	3.967			
							SD :	0.015	0.320			
Jun 13 90	Drift 11041, west of 11750											
	932							0.272	5.658			
	950	38.878	1438.490	27.336	1011.450	14.953	553.267	0.235	4.880	0.703	0.385	
	1008							0.231	4.805			
	1030							0.198	4.118			
	1045							0.227	4.722			
	1059							0.238	4.950			
	1115							0.202	4.202			
	1126	26.414	977.329	18.266	675.826	13.335	493.400	0.170	3.529	0.692	0.505	
	1158							0.194	4.035			
	1208							0.211	4.389			
	1223							0.205	4.264			
	1237							0.201	4.181			
								0.215	4.478			
								0.026	0.531			
Jun 26 90	Drift 16200											
	1022	22.480	831.870	9.180	339.790	2.210	81.700	0.082	1.706	0.408	0.098	A
	1133							0.070	1.456			A
	1211							0.138	2.870			B
	1236							0.132	2.746			B
	1246							0.134	2.787			C
	1256							0.113	2.350			C

Cont.

Table 16 - cont.

Jun 27 90	1239							0.131	2.725			D
	1246							0.130	2.704			D
Jun 28 90	Drift 11455											
	1054							0.388	8.070			A
	1106							0.388	8.070			B
	1127	53.650	1984.920	32.550	1204.240	26.520	981.110	0.320	6.656	0.607	0.494	C
	1146							0.320	6.656			C
	1226							0.370	7.696			A
	1239							0.343	7.134			B
	1254	44.330	1640.060	30.590	1331.930	22.950	849.180	0.288	5.990	0.690	0.518	C

Table 17 - Measurements by the Thomas-Tsivoglou method and according to the MDA-811 taken underground.

MDA-811
Quirke II u/g

	Thomas			MDA						
Date	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	Time	WL(1)	PAEC.(1) (uJ/m3)	WL(2)	PAEC.(2) (uJ/m3)	WL(1) / WL(Rn)	WL(2) / WL(Rn)
Jun 01 90	Drift 11041, west of 11850							0.00		
	918	0.221	4.60	925	0.14	2.96	0.18	3.77	0.64	0.82
	935	0.22	4.58	942	0.25	5.12	0.24	4.90	1.12	1.07
	956	0.222	4.62	1004	0.10	2.16	0.24	4.90	0.47	1.06
	1022	0.187	3.90	1024	0.17	3.50	0.16	3.39	0.90	0.87
	1041	0.214	4.45	1036	0.23	4.85	0.29	6.04	1.09	1.36
	—	—	—	1050	0.10	2.16	0.18	3.77	—	—
Jun 11 90	Drift 11041, west of 11850									
	1046	0.346	7.20	1041	0.32	6.74	0.31	6.41	0.94	0.89
	1205	0.218	4.53	1212	0.14	2.96	0.22	4.53	0.65	1.00
	1241	0.28	5.82	1225	0.18	3.77	0.16	3.39	0.65	0.58
	—	—	—	1243	0.21	4.31	0.25	5.28	—	—
Jun 13 90	Quirke II u/g Drift 11041, west of 11750							0.00		
	932	0.272	5.66	941	0.23	4.85	0.29	6.04	0.86	1.07
	950	0.235	4.88	1001	0.31	6.47	0.31	6.41	1.33	1.31
	1008	0.231	4.80	1019	0.22	4.58	0.17	3.51	0.95	0.73
	1030	0.198	4.12	1036	0.19	4.04	0.20	4.15	0.98	1.01
	1045	0.227	4.72	1049	0.23	4.85	0.15	3.02	1.03	0.64
	1059	0.238	4.95	1101	0.23	4.85	0.22	4.53	0.98	0.91
	1115	0.202	4.20	1117	0.16	3.23	0.09	1.89	0.77	0.45
	1126	0.170	3.53	1138	0.18	3.77	0.24	4.90	1.07	1.39
	1158	0.194	4.04	1156	0.25	5.12	0.16	3.39	1.27	0.84
	1208	0.211	4.39	1212	0.13	2.69	0.11	2.26	0.61	0.52
	1223	0.205	4.26	1228	0.06	1.35	0.22	4.53	0.32	1.06
	1237	0.201	4.18	1239	0.19	4.04	0.20	4.15	0.97	0.99

Table 18 - Measurements by the Thomas-Tsivoglou method and according to the MIMIL IIM.

Quirke II u/g

	Thomas			Mimil				
Date	Time	WL(Rn)	PAEC(Rn) (uJ/m3)	Time	WL(M)	PAEC(M) (uJ/m3)	posn.	PAEC(M) / PAEC(Rn)
Jun 01 90	Drift 11041, west of 11850							
	918	0.221	4.597	928	0.280	5.818		1.27
	935	0.22	4.576	945	0.290	6.036		1.32
	956	0.222	4.618	1011	0.251	5.218		1.13
	1022	0.187	3.896	1033	0.268	5.581		1.43
	1041	0.214	4.451	1051	0.248	5.163		1.16
Jun 11 90	Drift 11041, west of 11850							
	1046	0.346	7.197	1037	0.385	8		1.11
	1205	0.218	4.529	1206	0.267	5.545		1.22
	1241	0.28	5.824	1233	0.140	2.909		0.50
Jun 12 90	Stope 11680							
	1146	0.189	3.934	1200	0.247	5.145		1.31
	1210	0.212	4.410	1218	0.209	4.345		0.99
	1224	0.169	3.509	1232	0.198	4.109		1.17
	1258	0.193	4.014	1253	0.170	3.545		0.88
Jun 13 90	Drift 11041, west of 11750							
	932	0.272	5.658	935	0.310	6.454		1.14
	950	0.235	4.880	950	0.297	6.181		1.27
	1008	0.231	4.805	1009	0.299	6.218		1.29
	1030	0.198	4.118	1032	0.219	4.563		1.11
	1045	0.227	4.722	1046	0.235	4.89		1.04
	1059	0.238	4.950	1100	0.244	5.072		1.02
	1115	0.202	4.202	1116	0.161	3.345		0.80
	1126	0.170	3.529	1137	0.216	4.49		1.27
	1158	0.194	4.035	1155	0.199	4.145		1.03
	1208	0.211	4.389	1211	0.244	5.072		1.16
	1223	0.205	4.264	1226	0.230	4.781		1.12
	1237	0.201	4.181	1241	0.246	5.109		1.22
Jun 14 90	Near 11680							
				926	0.127	2.636	A	
				1050	0.109	2.272	A	
				944	0.129	2.69	B	
				1105	0.109	2.272	B	
				1000	0.130	2.709	C	
				1120	0.122	2.545	C	
				1018	0.133	2.763	D	
				1135	0.126	2.618	D	
				1035	0.204	4.236	E	
				1150	0.209	4.345	E	
Jun 26 90	Drift 16200							
	1022	0.082	1.706				A	

Cont.

Table 18 - cont.

	1133	0.070	1.456				A	
	1211	0.138	2.870				B	
	1236	0.132	2.746				B	
	1246	0.134	2.787				C	
	1256	0.113	2.350				C	
Jun 27 90	1239	0.131	2.725				D	
	1246	0.130	2.704				D	
Jun 27 90	Drift 11600							
				945	0.000	1.381	A	
				1138	0.000	1.29	A	
				1031	0.000	6.29	B	
				1057	0.066	2.181	B!	
				1111	0.062	2.727	B!	
				959	0.302	1.763	C	
				1204	0.105	1.309	X	
Jun 28 90	Drift 11455							
	1054	0.388	8.070	1101	0.418	8.69	A	1.08
	1106	0.388	8.070	1115	0.415	8.636	B	1.07
	1127	0.320	6.656	1129	0.465	9.672	C	1.45
	1146	0.320	6.656	1147	0.413	8.6	C	1.29
	1226	0.370	7.696	1233	0.367	7.636	A	0.99
	1239	0.343	7.134	1247	0.392	8.163	B	1.14
	1254	0.288	5.990	1306	0.350	7.272	C	1.21

Table 19 - ^{222}Rn progeny daily average data by the Thomas-Tsivoglou (or Kusnetz) method, and as measured by the MDA-811 and the MIMIL IIM.

Date	Instrument	WL(1)	PAEC(1) (μJm^{-3})	WL(2)	PAEC(2) (μJm^{-3})	WL(M)	PAEC(M) (μJm^{-3})	WL(Rn)	PAEC(Rn) (μJm^{-3})
June 1/90	MDA-811	0.17±0.06	3.46±1.18	0.21±0.04	4.46±0.91	-	-	0.21±0.01	4.43±0.27
"	MIMIL IIM	-	-	-	-	0.27±0.07	5.56±1.51	0.21±0.01	4.43±0.27
June 11/90	MDA-811	0.21±0.07	4.44±1.54	0.24±0.08	4.90±1.82	-	-	0.28±0.05	5.85±1.09
"	MIMIL IIM	-	-	-	-	0.26±0.1	5.48±2.08	0.28±0.05	5.85±1.09
June 12/90	MIMIL IIM	-	-	-	-	0.21±0.03	4.29±0.57	0.19±0.02	3.96±0.37
June 13/90	MDA-811	0.20±0.06	4.15±1.26	0.19±0.06	3.75±1.65	-	-	0.21±0.02	4.48±0.53
June 13/90	MIMIL IIM	-	-	-	-	0.24±0.04	5.03±0.86	0.21±0.02	4.48±0.53

Table 20 - Values for the ratio PAEC(X)/PAEC(Rn) and P(X)

Date	Instrument	PAEC(1)/PAEC(Rn)	P(1) %	PAEC(2)/PAEC(Rn)	P(2) %	PAEC(M)/PAEC(Rn)	P(M) %	P(Rn) %
June 1/90	MDA-811	0.78	34.1	1.01	20.4	-	-	6.1
"	MIMIL IIM	-	-	-	-	1.25	27.2	6.1
June 11/90	MDA-811	0.75	34.7	0.84	37.0	-	-	18.6
"	MIMIL IIM	-	-	-	-	0.94	37.0	18.6
June 12/90	MIMIL IIM	-	-	-	-	1.08	13.3	9.3
June 13/90	MDA-811	0.92	30.4	0.84	44.0	-	-	11.8
"	MIMIL IIM	-	-	-	-	1.12	17.1	11.8

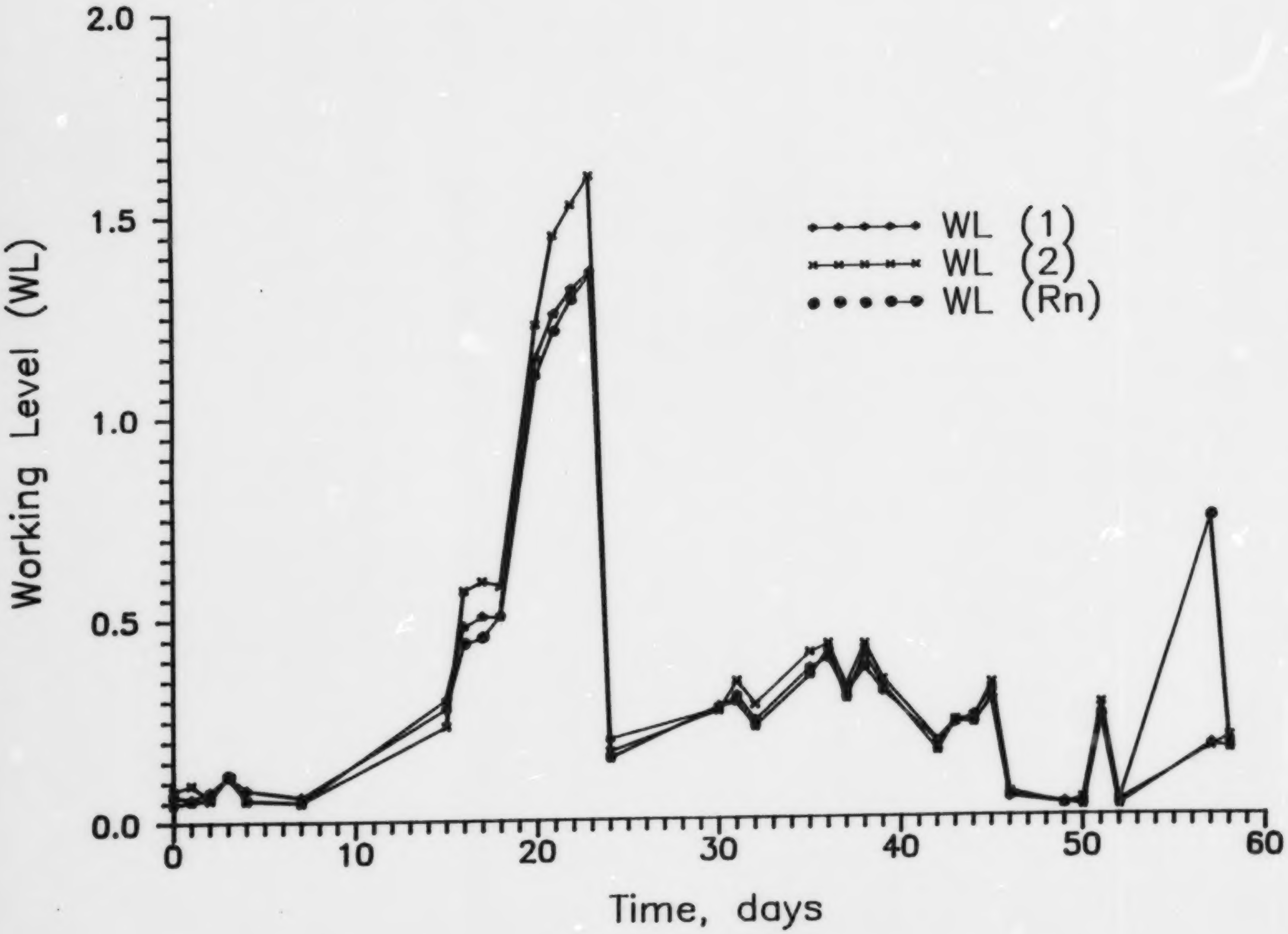

Fig. 1. Daily averages of the Working Level (MDA–811 and Thomas–Tsivoglou) versus date

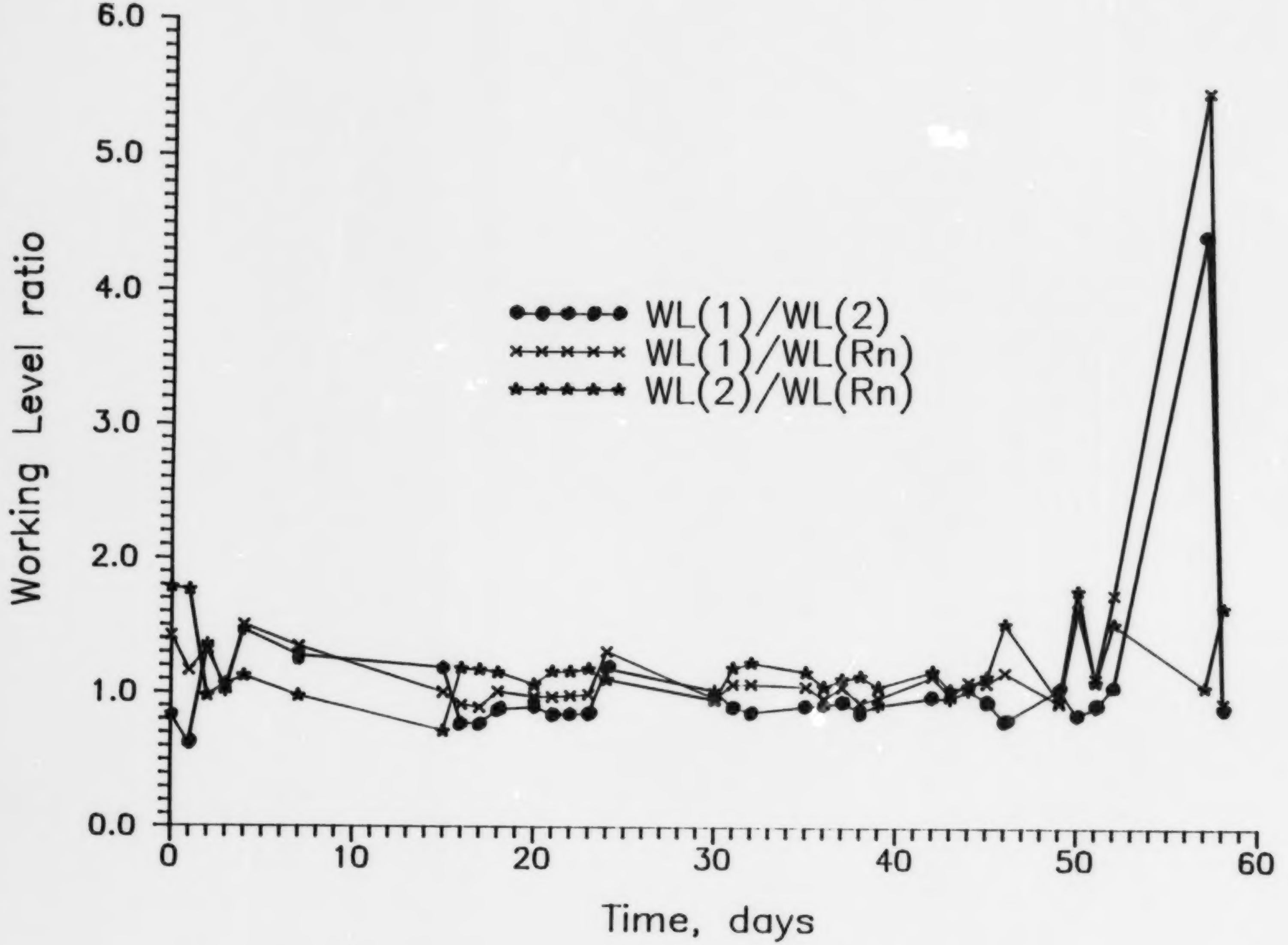

Fig. 2. Daily averages of WL(1)/WL(2), WL(1)/WL(Rn), and WL(2)/WL(Rn) versus date

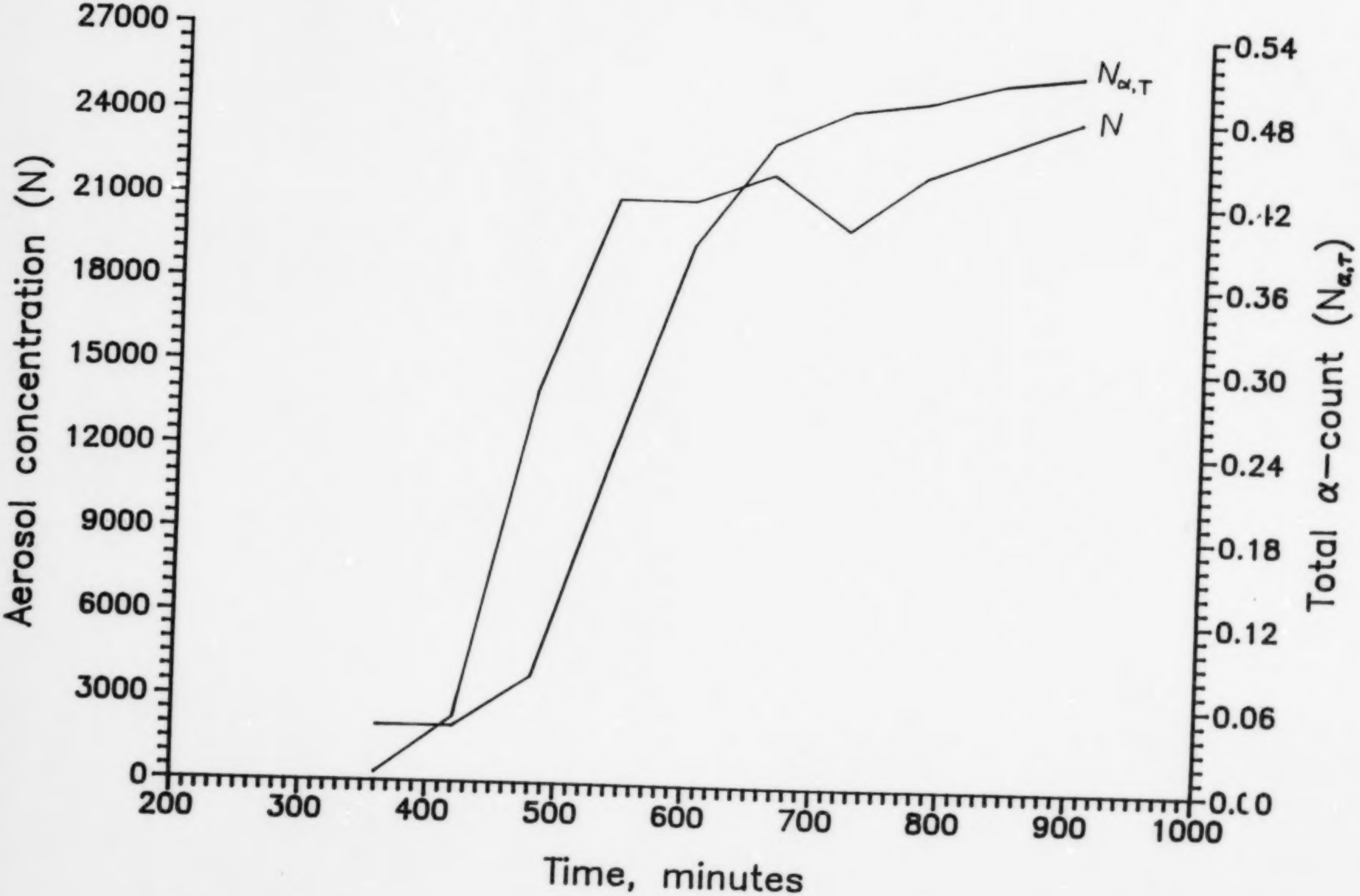

Fig. 3a. Effect of aerosol concentrations (N) on the WLM—30 Working level. WL(30)

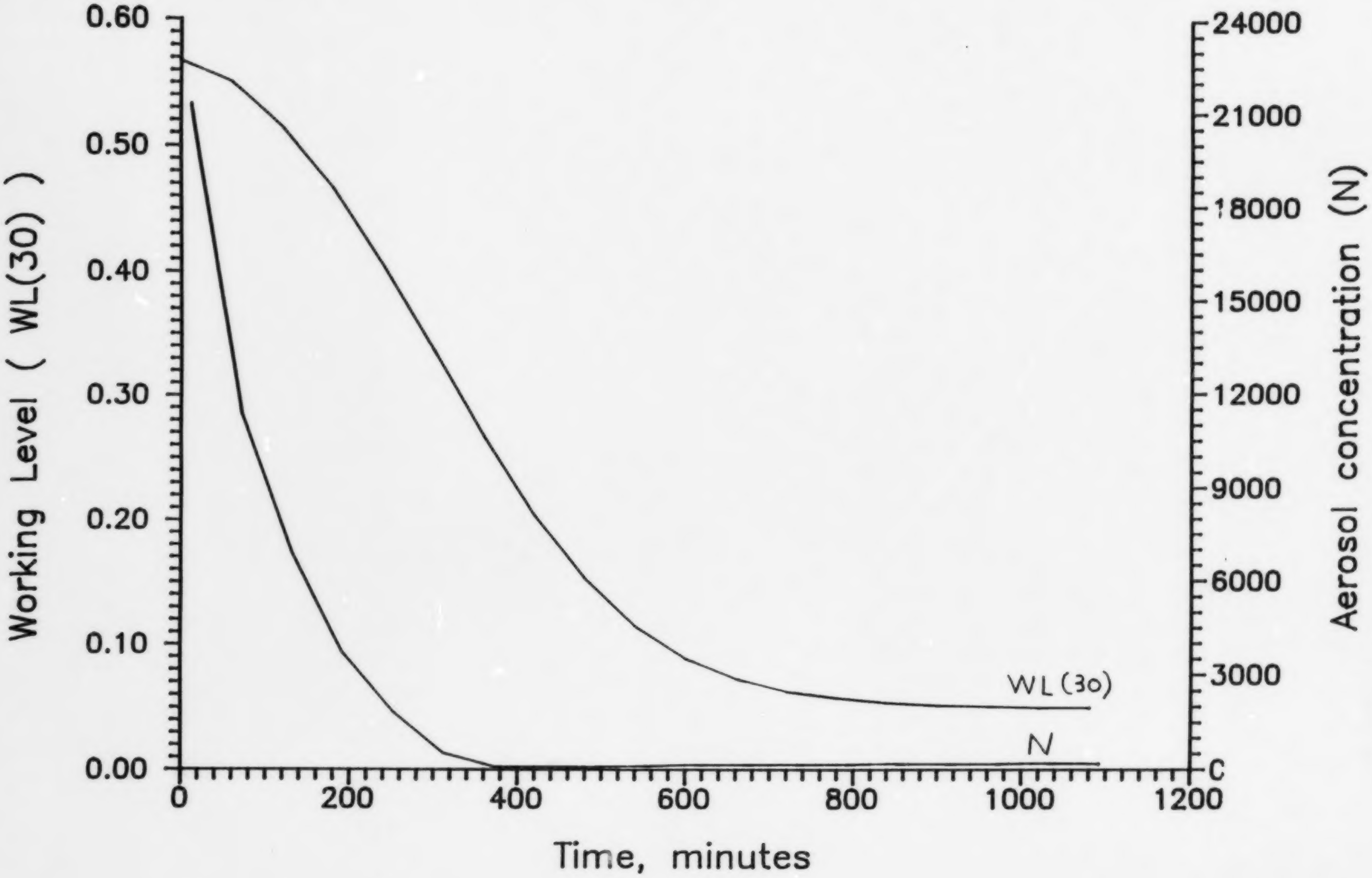

Fig. 4. Effect of aerosol concentrations (N) on the WLM-30 Working level. WL(30)

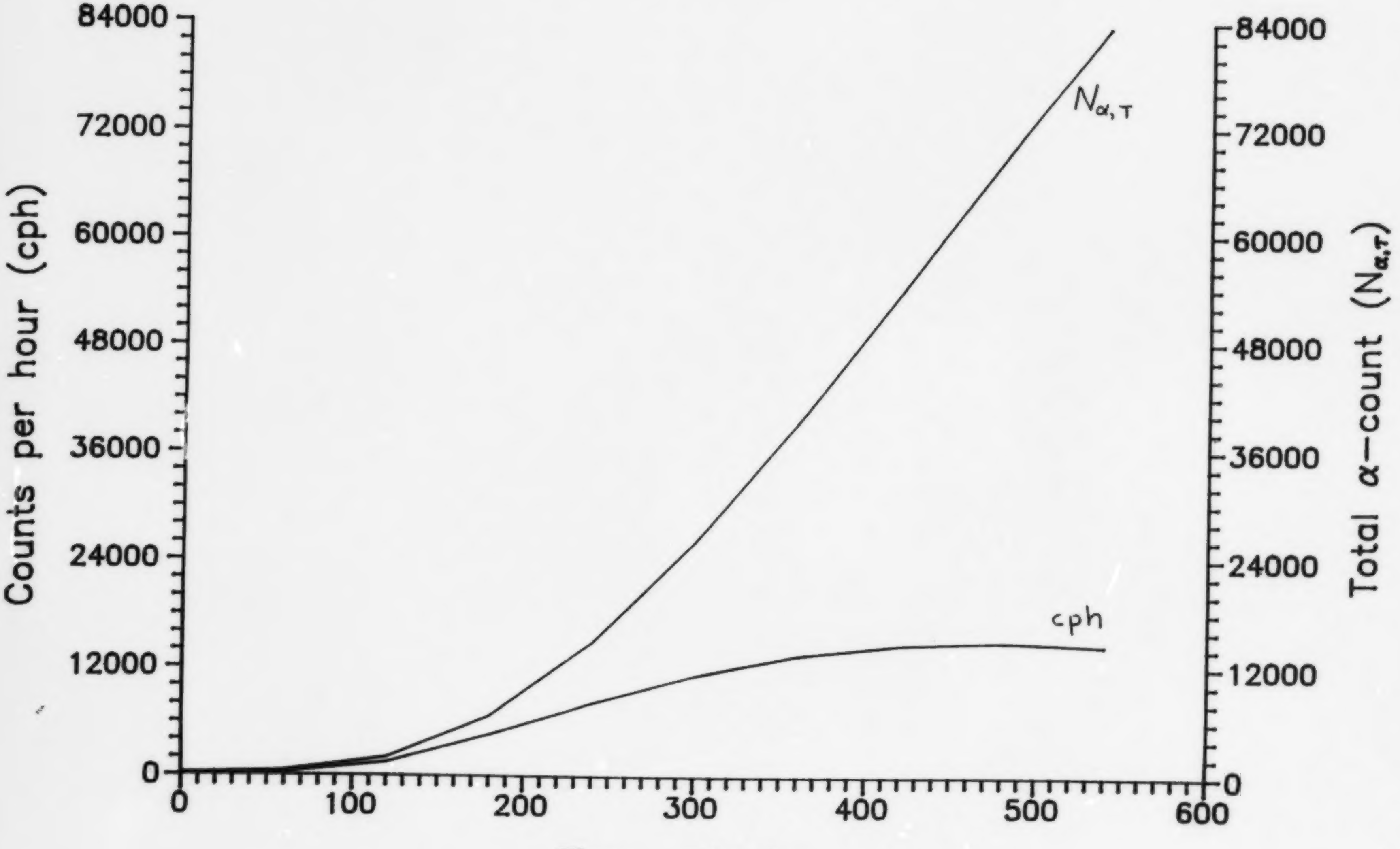

Fig 5. α−particle count rate and total count for the WLM−30 versus time

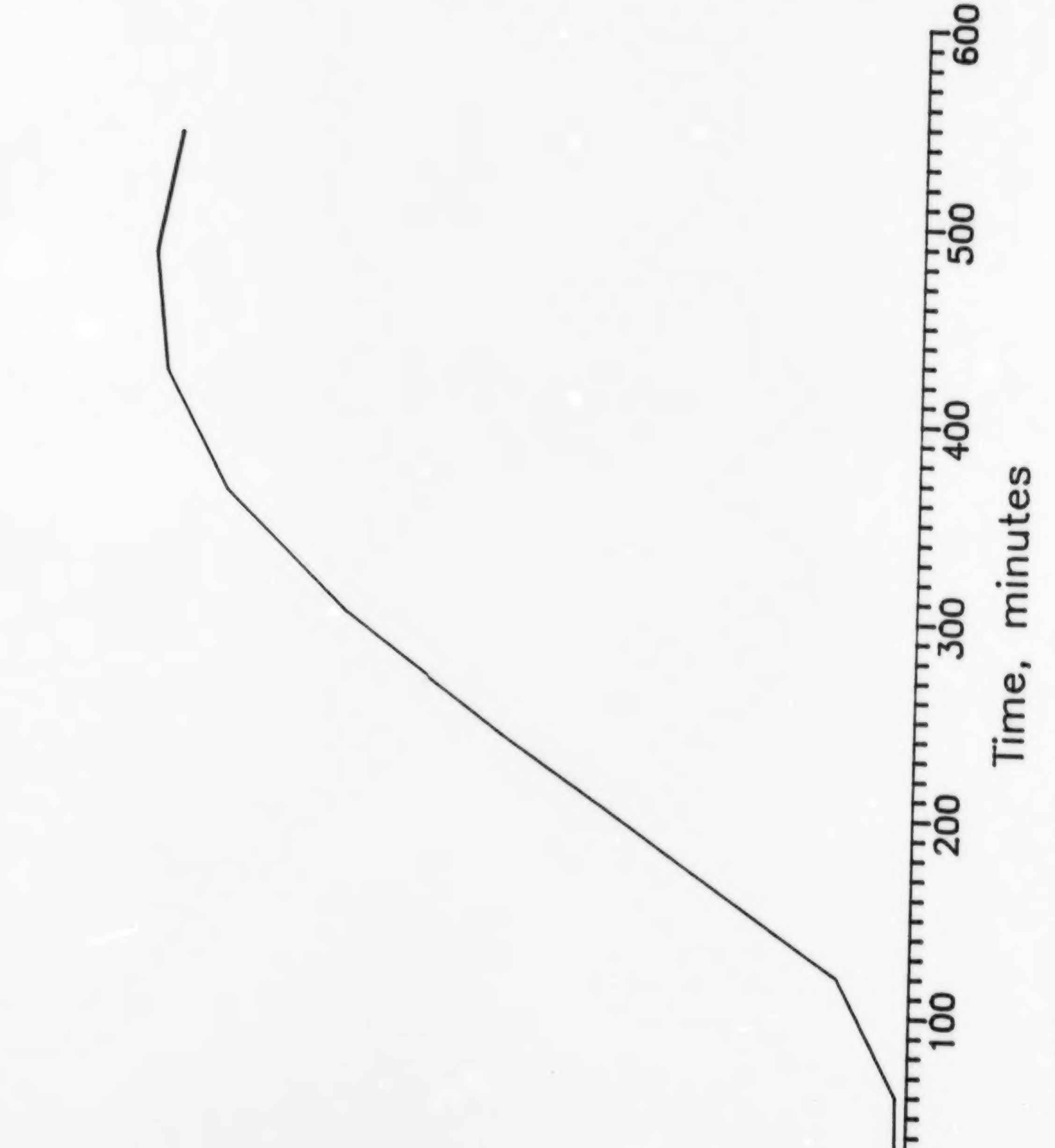

Fig 6. EDA WLM-30 Working Level versus time (growth of radioactivity in sampling filter)

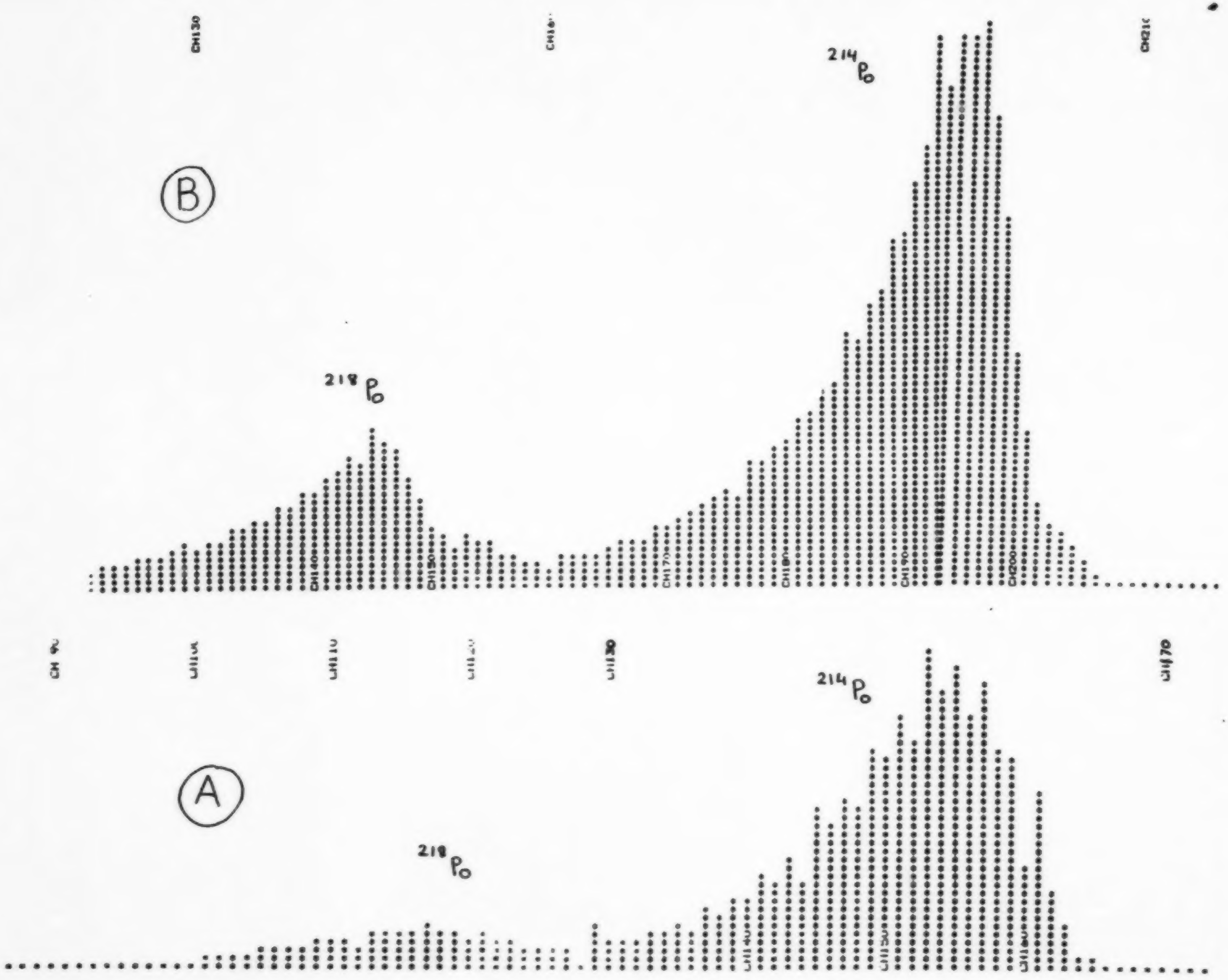

Fig. 7 - (trace A), and Fig. 8 - (trace B) show α-particle spectra when aerosol loading occurs and under low aerosol concentration conditions, respectively. (Notice broadening and energy shift of A relative to B.)

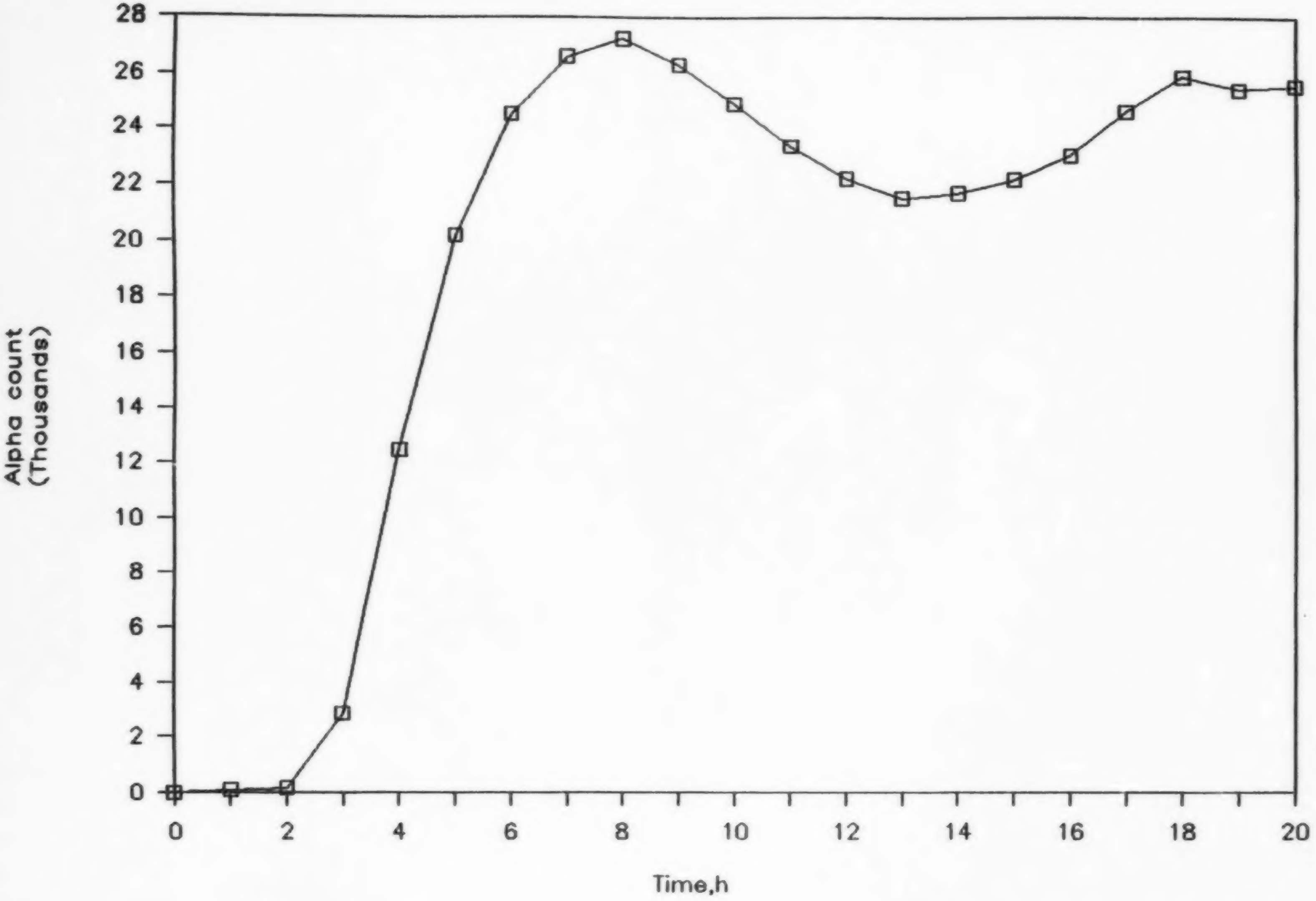

Fig. 9 - Typical EDA WLM-30 alpha-particle count (counts per hour) versus time.

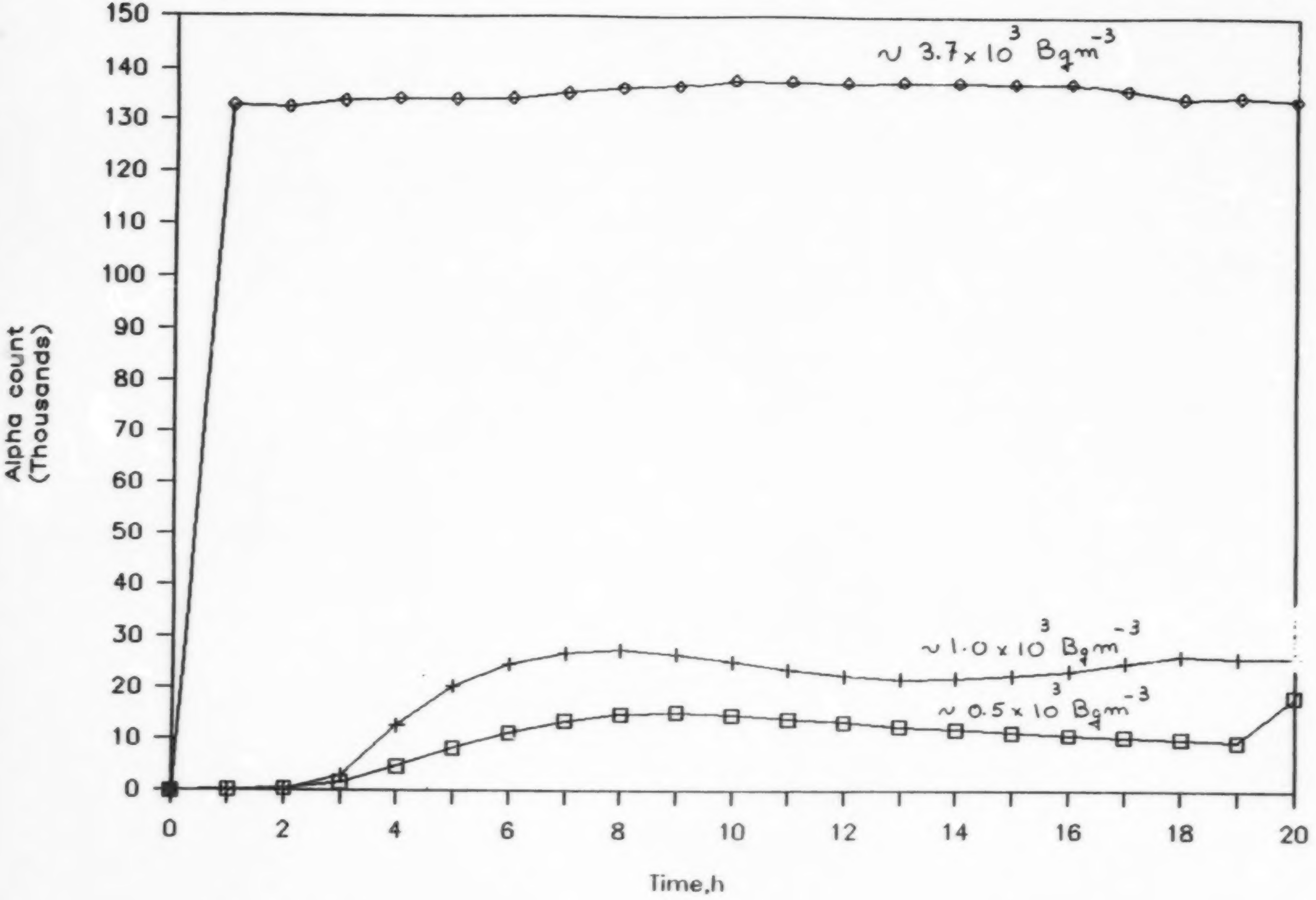

Fig. 10 - Alpha-particle count (counts per hour) recorded by the EDA WLM-30 versus time for several ^{222}Rn concentration levels.

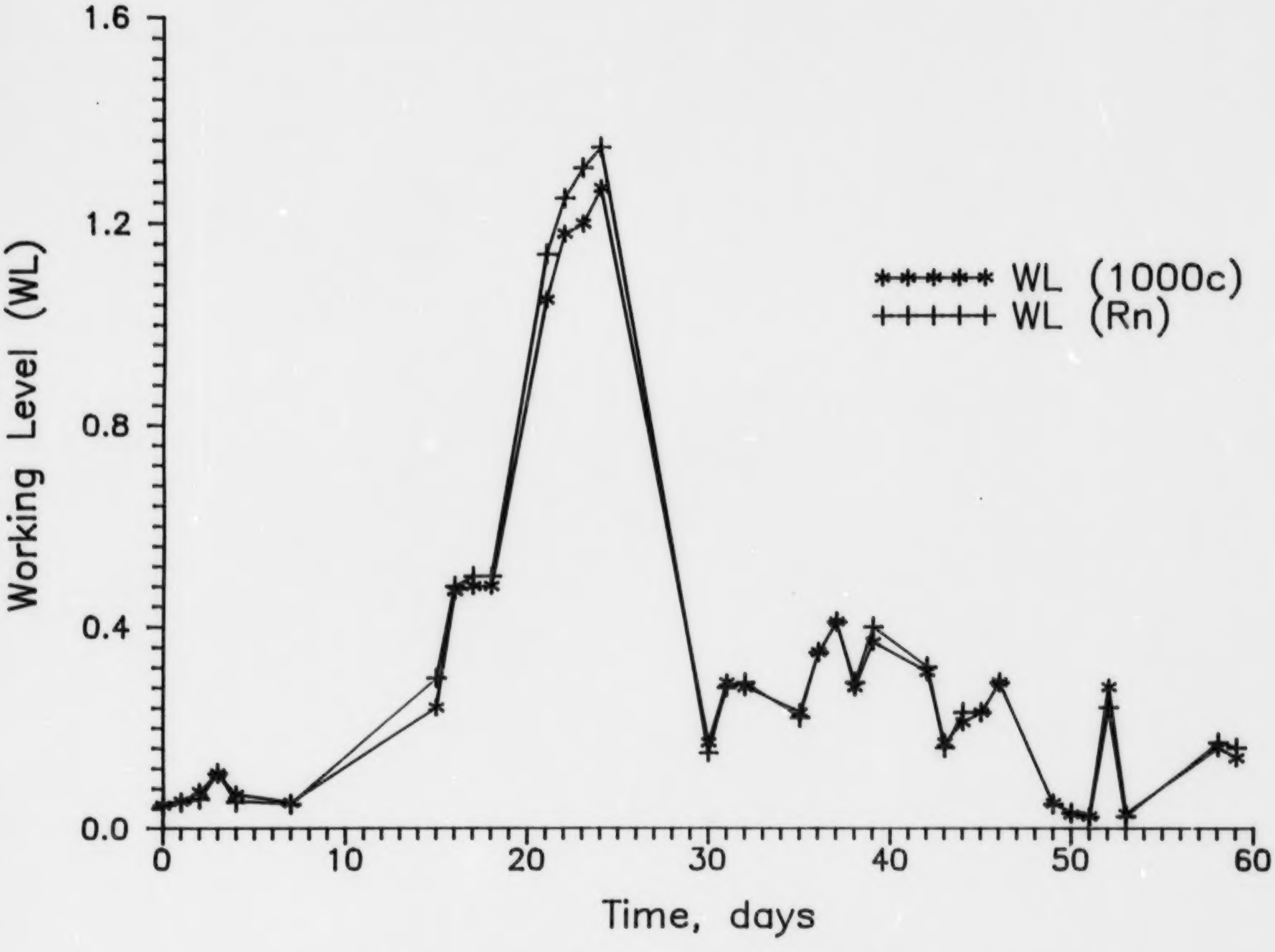

Fig. 11. Daily averages of WL(1000c) and WL(Rn) versus date

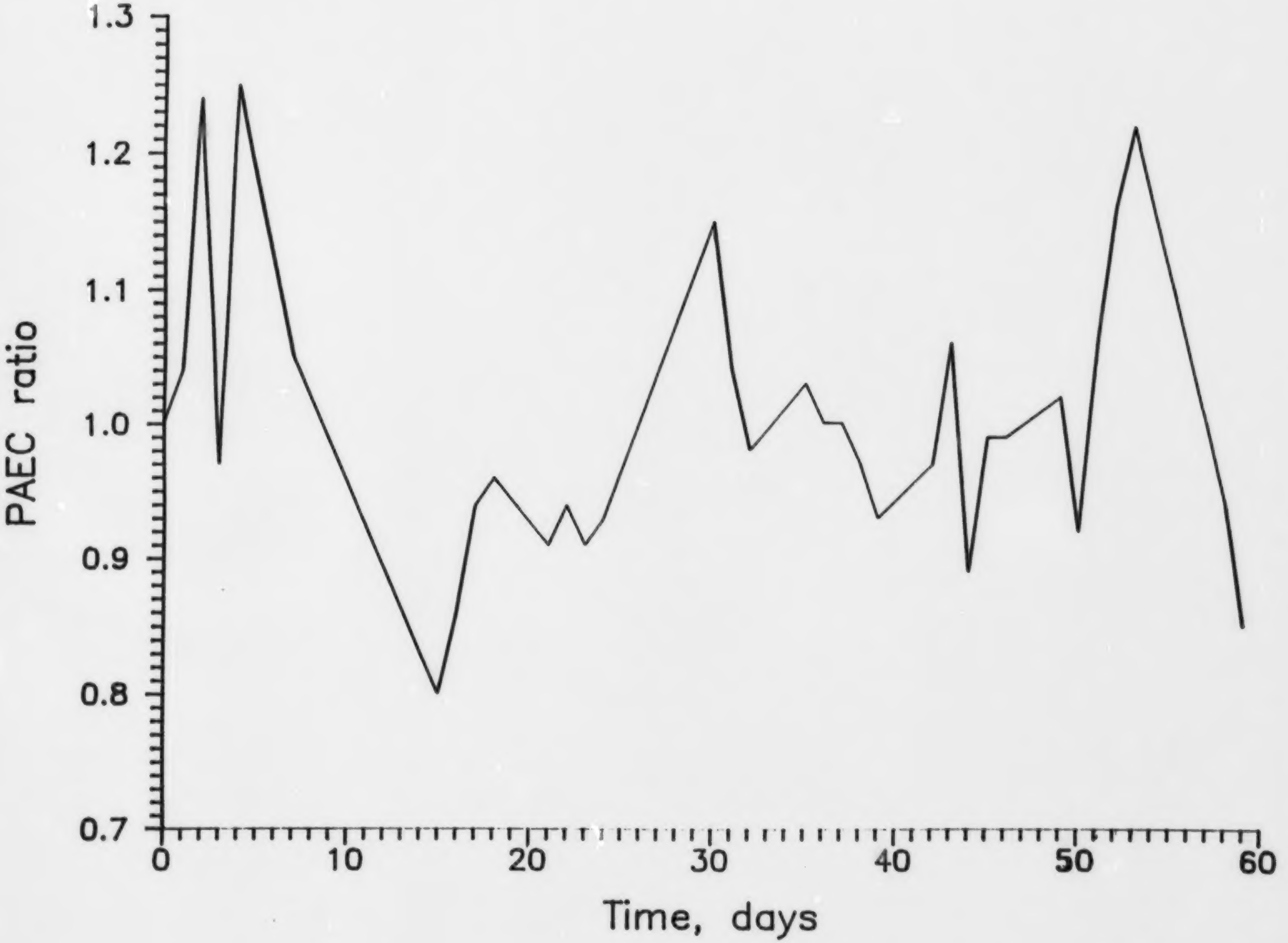

Fig. 12. Daily averages of PAEC(1000c)/PAEC(Rn) versus date

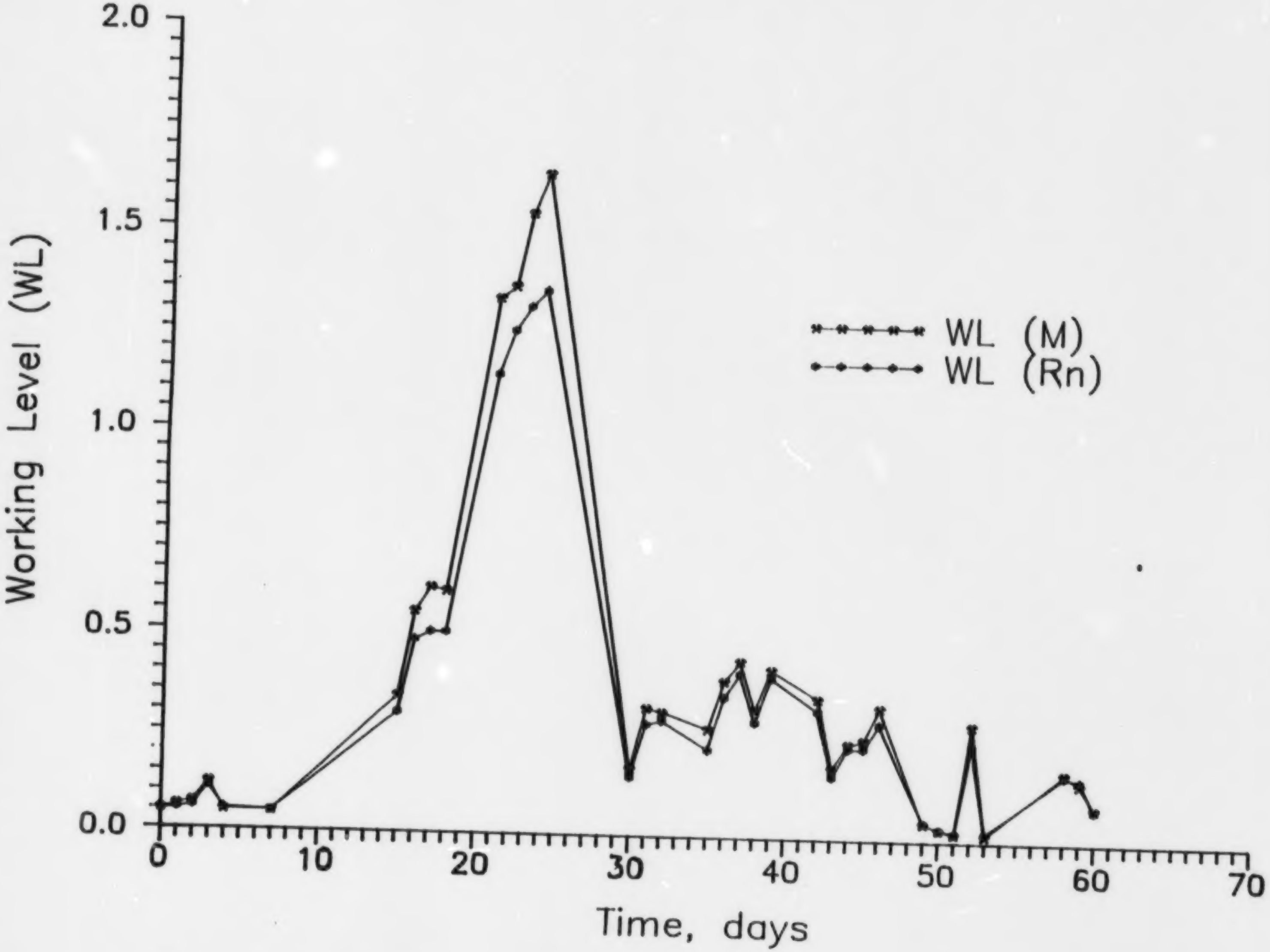

Fig. 13. Daily averages of WL(M) and WL(Rn) versus date

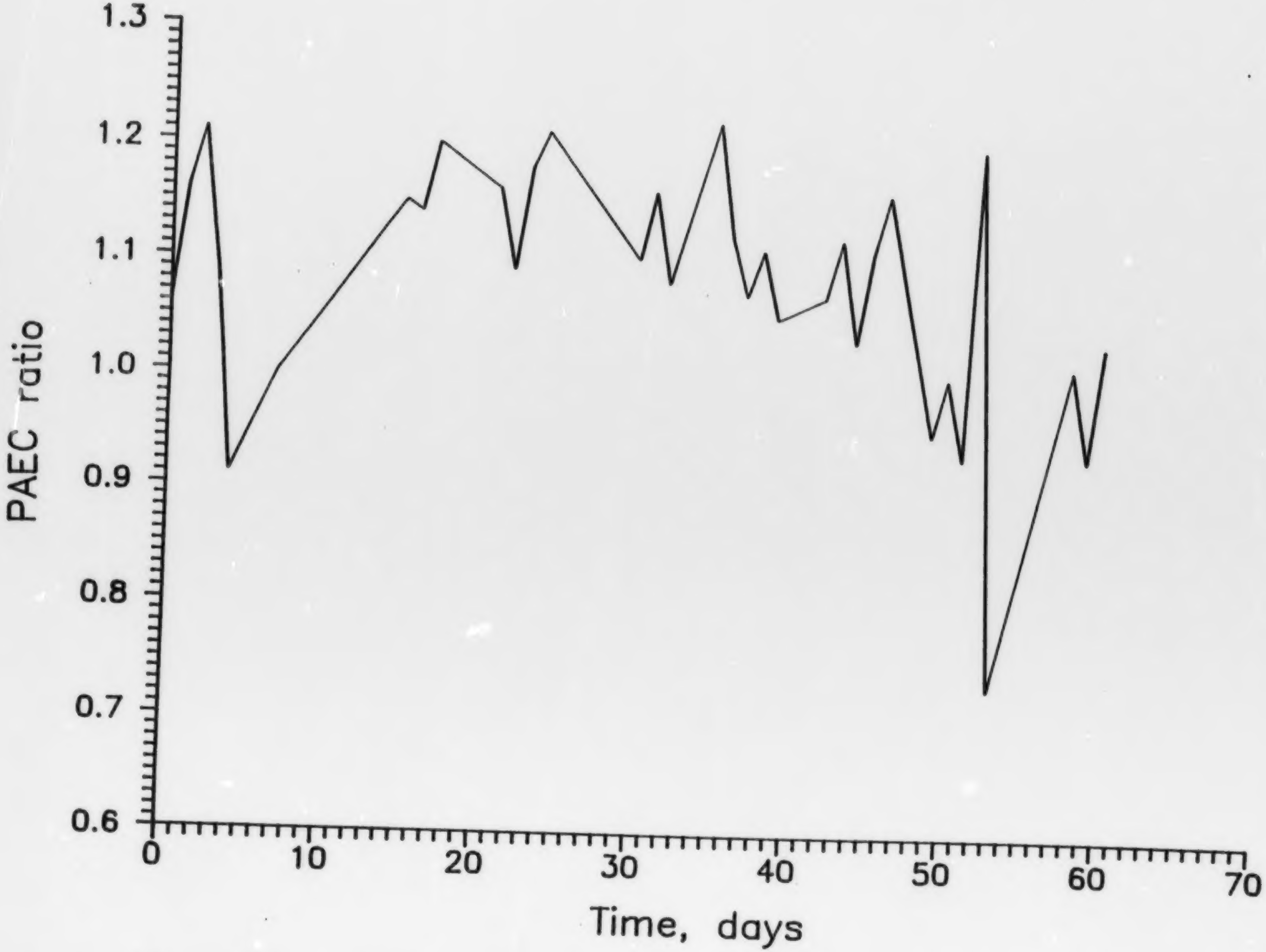

Fig. 14. Daily averages of PAEC(M)/PAEC(Rn) versus date